Forestry

JUN 17 1935

VETERINARY MEDICINE

July 1935

CONTENTS

Ohio Veterinary Conference 275

Recent Progress in the Physiology of Digestion 276

Veterinary Service in Rural Public Health 282

The Present Status of Blood Examinations 289

Nutrition in Relation to Animal Health 296

Reenforcement of Milk with Vitamin D 302

Prevention and Treatment of Parasites 307

Internal Parasites of Dogs and Cats 312

The Production and Handling of Dairy Products 316

Do You Remember? 318

Treatment of Gastro-Enteritis in Dogs 319

Illegitimate Use of Drugs on Race Horses 321

Diagnostic Methods in Small Animal Practice 323

The Laboratory Dog 330

Illness a "Big Business" 330

VOL. XXX
No. 7

Entered as second-class matter Nov. 8, 1920, at the post office at Chicago, Ill., under the Act of March 3, 1879.

75 E. Wacker Drive
Chicago, U. S. A.

Junior FORT DODGE BIO-CHEMIC REVIEW

JULY 1935

IMPORTANT! Four new Fort Dodge products are announced in the Summer Number of the Bio-Chemic Review -- Calcidex Solution, Nickamala Tablets, Anti-Enteritis Serum Feline and Potassium Iodide Tablets (30 gr.). Be sure to read about them.

PRACTICAL SMALL ANIMAL PRODUCTS

• America's millions of dogs and cats offer an ever-growing and increasingly profitable field for the veterinary profession.

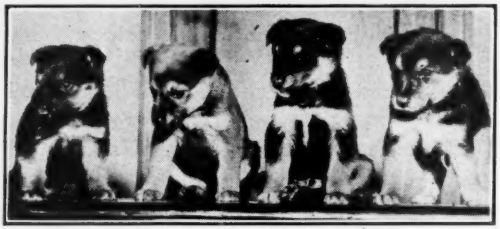
That is why Fort Dodge has taken particular pains to develop an outstanding line of pharmaceutical and biological products for use on small animals. This entire Fort Dodge line is up-to-the-minute and always practical. It offers a wide selection to fit your every need.

•

If You Pass Our Way This Summer, Stop In

• If you plan a vacation drive over the Jefferson or Lincoln highways this summer, remember, Fort Dodge—in north-central Iowa—is only a few miles off those transcontinental routes. Why not take a 'side tour' and pay us a visit. We'll be mighty glad to see you and show you around our laboratories.

CAMERA!



WILD DOGS—A New Jersey posse captured this quartet of marauding pups. © Keystone.

4 BIG DAYS

• August 27 to 30—those are the dates of this year's annual meeting of the A. V. M. A. (Oklahoma City is the place.) Mark your calendar—and be there.

UTILITARIAN DRUG AS FORT DODGE SPECIALTY

• Scarcely a day goes by that a small animal practitioner does not dispense some tincture of iodine. (And every emergency bag holds a vial.) You are sure to like the new Fort Dodge Tincture of Iodine in one-ounce applicator bottles. Ask your Fort Dodge service man.

SITTING TIGHT—An Australian cowgirl stays in her saddle. © Keystone.

Veterinary Medicine

Registered in U. S. Patent Office

VOL. XXX JULY, 1935 No. 7

Published Monthly by the Veterinary Magazine Corporation
75 East Wacker Drive, Chicago, Ill., U. S. A.
$4.00 a Year; per Copy 50 Cents.

Copyrighted 1935, by Veterinary Magazine Corporation.

All matter appearing in this publication is covered by copyright, and no part of it may be reproduced without permission. Permission will be granted on request for reproduction of anything in the columns of VETERINARY MEDICINE if the purpose of the reproduction is unobjectionable. Where there is any doubt as to the propriety of reproduction, the wishes of the author will be consulted.

D. M. Campbell, Editor A. T. Kinsley, Associate Editor
H. J. Mostyn, R.K.O. Bldg., New York, Eastern Representative

The Ohio Veterinary Conference

Veterinary Conferences, or Short Courses, or Post Graduate Courses as they are variously called, are in the main, a recent development in this country. Prior to the World War, such assemblies were confined to two states; within the past decade, veterinary schools, agricultural colleges or universities in more than a dozen states have sponsored such courses annually. Some of them have built up an attendance of veterinarians not only from surrounding states, but from more distant commonwealths.

Veterinary Conferences were developed to fill an acute need—to meet an immediate demand. Equine practice reached its maximum in 1910 and started to diminish in amount and importance. Its descent was arrested before it had gone far by the war in Europe and the consequent high price of horses. Our entry into the war obliterated established programs and diverted the normal course of change. When it was over, thousands of veterinarians were facing a new world of practice. That with which they were familiar was obsolescent; their semiology must be elaborated to include ailments of poultry and swine, basic pathology must be extended to include diseases of these animals and new concepts of disease in the dairy cow, parasitology must be relearned and former teaching as to nutrition unlearned and replaced with something almost wholly different.

In this reëducation of the practitioner, Veterinary Conferences have been useful. They achieved an immediate popularity, which on the whole is now after a decade probably waning. However, the annual conference held under the auspices of the College of Veterinary Medicine, Ohio State University, has shown an increase in attendance from year to year; the registration at the most recent one numbering 381 and including veterinarians from 19 states. An innovation is the publication of practically all of the veterinary lectures at this conference in VETERINARY MEDICINE. While this furnishes less than the usual variety or scope of an issue of this magazine, it is believed that most veterinarians will appreciate an opportunity to read and to retain for reference the proceedings that attracted others from Massachusetts to Kansas and from Wisconsin to Alabama. To make it a more realistic "conference at home," halftones of the speakers and of others who attended this conference have been included with the report.

The Author

Recent Progress in the Physiology of Digestion*

By H. H. DUKES, Ithaca, New York, Department of Physiology, New York State Veterinary College at Cornell University

DIGESTION includes all processes whereby foods in the alimentary tract are prepared for absorption. The factors concerned in bringing about digestive changes are chemical and mechanical. The chemical factors are: (1) enzymes, both those produced by the digestive glands and those present in the foods; (2) bacteria, and possibly in some species protozoa; and (3) chemical substances, other than enzymes, produced by the digestive glands, e. g. hydrochloric acid.

THE enzymes produced by the digestive glands are important aids to digestion in all animals but appear to be of greatest importance in carnivores and omnivores. Food enzymes are of importance in herbivores but of little or no importance in carnivores. Bacteria are of greatest usefulness in digestion in herbivores, cellulose solution in these animals being the best known and apparently the most important example of bacterial digestion. In digestion in herbivores, particularly of starch, the relative importance of enzymes produced by the animal itself, of enzymes present in the food, and of bacteria cannot be stated definitely at the present time.

THE chief mechanical factors of digestion are mastication, deglutition, regurgitation, vomition, gastric and intestinal motility and defecation.

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

Since all digestive changes may be said to be, ultimately, chemical in nature, it is evident that the mechanical factors of digestion must operate simply to facilitate the chemical changes. Nevertheless many, possibly most, of the digestive disorders with which the clinician has to deal are due basically to upsets of the mechanical factors. The abnormal chemical changes that often accompany dysfunction of the mechanical factors frequently correct themselves when the motor activities are restored to normal.

Since it is impossible in the time at my disposal to give a connected account, even in summary, of the physiology of digestion, I have decided simply to touch upon certain parts of the subject that seem to be of general interest and importance or in which recent or fairly recent progress has been made.

The Amylolytic or Starch-Splitting Function of Saliva

It is generally agreed that saliva functions mainly in a physical way, i. e. as a watery secretion, facilitating chewing, taste stimulation, bolus formation, and swallowing. In some animals, and in man, however, it has, by virtue of the enzyme ptyalin, the additional function of converting starch to sugar. Contrary to what might be supposed, the saliva of the horse, ox, sheep, and goat—herbivores—contains practically no ptyalin. Virtually all recent workers are in agreement on this point. That the saliva of carnivores, such as the dog, cat, and fox, should contain little or no ptyalin is more understandable. Among domestic animals the pig appears to stand apart in possessing a saliva containing amylase in really significant

amounts. Even in this animal the starch-splitting power of saliva is much weaker than in man.

Can the Dog Digest Starch?

To some of you such a question may seem physiologically naïve, with an affirmative answer almost axiomatic. Nevertheless, there is a surprising number of people who believe that the dog is unable to digest starch. This belief is probably based on the fact that the dog is by nature a carnivore and that the saliva of the dog contains, according to the work of most investigators, little or no starch-splitting enzyme. Because of this rather widespread belief in the essential inability of the dog to digest starch, it may be worth while to call attention to the considerable body of evidence, both practical and scientific, that the dog is able to digest starch even when it is fed in large amounts:

1. It is a well-known fact that many dogs are kept in a healthy condition on diets high in starch.

2. The Dechambre and the Linton standard each calls for a large amount of carbohydrate.

3. There are some recent, carefully controlled laboratory experiments which point unmistakably to the conclusion that the dog is able to digest and absorb starch, either cooked or raw, even when fed in large amounts and that the digestive juices of the dog, particularly the pancreatic juice, are not lacking in starch-splitting power (Roseboom and Patton).

The Significance of the Cardiac Glands

In the simple stomach, cardiac, fundus and pyloric gland zones are found. In some animals an additional non-glandular, esophageal, zone is present. It is large in the horse, small in the pig. The fundus glands are the proper gastric glands. The pyloric glands produce a scanty secretion containing mucus and a protein-splitting enzyme. The significance of the cardiac glands, especially in the pig, in which animal they occupy such an extensive zone, has been the subject of a good deal of controversy. Bensley, who has made an extensive study of the cardiac glands, is of the opinion that they are mucous glands and therefore do not produce enzyme. According to this worker they are to be regarded as retrogressive structures derived from the fundus glands and destined ultimately to disappear. The glandless esophageal zone of the horse and the glandless rumen, reticulum, and omasum of the ruminant would, on the basis of this view, be regarded as regions from which gastric glands have entirely disappeared in the course of evolution; the stomach, in the ruminant, at the same time having undergone extensive modifications in form. It would thus seem, if these views are correct, that the horse and pig are slowly losing the glands of the stomach; those of the esophageal zone have already disappeared, those of the cardiac zone are disappearing. Such questions as these immediately come to mind: How far will the degenerative changes extend into the fundus glands? Will the horse and pig, and perhaps all plant-feeders, develop something akin to the (according to this view) phylogenetically more recently developed ruminant stomach?

Why Are Some Animals Unable to Vomit?

Rodents, ruminants, and solipeds seldom or never vomit, whereas carnivores and om-

An Ohio Pair
C. H. Case, Akron, and W. F. Guard, O. S. U.

nivores (except rodents) vomit readily. Various theories have been advanced to explain why certain animals do not vomit. The absence of rudimentary development of the nerve center of vomiting is held by some to be the chief cause. Others believe, on the contrary, that the lack or poor development of a vomiting center is the effect, rather than the cause, of the absence of vomiting. The original purpose of vomiting was doubtless to assist animals in combating poisons taken in with the food, and it has been suggested that rats, and possibly other non-vomiting animals, owe their inability to vomit to the development of more effective means of combating poisoning, for example, selective absorption. Nausea, which is experienced also by animals that do not vomit, would stop the ingestion of poisonous material and, by closure of the pylorus, delay its passage into the intestine, while selective absorption would delay or prevent its entry into the blood. Hence vomiting would not occur. This condition, often repeated in successive generations, would lead eventually to inability to vomit because of long disuse of the vomiting center. In many animals vomiting still remains the principal means of combating poisoning, although the frequent occurrence of death in poisoning even though vomiting has occurred testifies to the imperfection of the protective mechanism. Perhaps the protection afforded by nausea and selective absorption is more efficient. There is some evidence that it is.

Are Rumen, Reticulum and Omasum Parts of the Esophagus or Parts of the Stomach?

Because the mucous membrane of these compartments is non-glandular and the epithelium is of the stratified squamous type, they are sometimes regarded as esophageal dilations or proventriculi. Embryological studies indicate, however, that such a view is erroneous; they are derived from the embryonic stomach and not from the esophagus. As indicated above, rumen, reticulum, and omasum may possibly represent regions which have lost their gastric glands while undergoing extensive phylogenetic modifications in size and form, probably due to the coarse, bulky food.

Regurgitation

Rumination embraces those digestive processes whereby food in the stomach is regurgitated, remasticated, reinsalivated, and reswallowed. Regurgitation is thus a part of a complicated series of events. The food returned to the mouth doubtless comes in part from the rumen and in part from the reticulum. The mass to be regurgitated is highly mixed with liquid and its entrance into the esophagus is accomplished by an inspiratory effort with a closed glottis. Reverse peristalsis of the esophagus then probably assists in the return of the food to the mouth, although the momentum with which the food is projected into the esophagus must be a factor in its retrograde passage. There is strong evidence that contraction neither of the abdominal muscles nor of the wall of the rumen plays any direct part in regurgitation. Likewise it has been shown that activity of the esophageal groove is of no concern in regurgitation. Contraction of the reticulum is more directly related to regurgitation but even here the contraction precedes regurgitation, though by a very brief interval.

Rumination is essentially a reflex act, although several of its phases can be controlled voluntarily within wide limits. The numerous muscles—some striated, some nonstriated—and the several glands concerned in the act of rumination are assumed to be under the coordinating influence of a rumination center, probably located in the brainstem.

The Function of the Esophageal Groove

As is well known, the esophageal groove begins at the cardia and extends to the reticulo-omasal orifice. This organ still remains pretty much of a physiological enigma. At one time it was assumed, largely on the basis of anatomical studies, that the esophageal groove served to convey liquid and semiliquid ingesta from the cardia directly to the reticulo-omasal orifice without their having

to pass through the rumen and reticulum. It was believed that the groove functioned particularly in conveying food from the esophagus to the omasum and abomasum during rumination. However, when the physiology of the ruminant stomach began to be studied by means of the rumen fistula, it soon became evident upon direct examination of the groove, both during eating and during rumination, that little or no material ordinarily passed along it in mature animals. Studies in the calf, however, show that the groove does function, apparently by reflex closure, as a conduit for milk or water on its way from the esophagus to the reticulo-omasal orifice. The reflex closure caused by water disappears a few weeks after birth whereas the reflex closure caused by milk may continue for months. In young healthy cattle up to two years old, the reflex can be evoked, according to Wester, by the administration of various chemical substances in solution, including sodium salts, especially sodium chloride and sodium bicarbonate, and sugar. This investigator therefore recommends the giving of groove-closing substances prior to the administration of drugs not intended for the rumen or reticulum but for the abomasum. Wester's work was done on cattle. In South Africa, Mönnig and Quin have studied the possibility of dosing into the abomasum of sheep, using Wester's work as the basis of their experiments. Results, recorded on 264 animals, were of such a nature that practically no conclusions could be drawn. They admit the possibility of a groove-closing reflex, but important factors that modify it were not revealed by their experiments. Evidently further work is necessary.

Intestinal Motility

In recent years, work from a number of laboratories has shown that intestinal movements are much more complicated than was formerly thought. Extensive studies of intestinal motility have been made in several species of small animals, both carnivorous and herbivorous. Exact knowledge of the movements in the farm animals, however, is very limited. Research work should be done in this field, and it should first be directed toward a determination of the extent to which our knowledge of the movements in small animals is applicable to the farm animals. However, the economic and other hindrances are great.

There are a number of practicable methods of studying intestinal motility. In one of the best of these the abdomen of the anesthetized animal is opened and then promptly submerged in a bath of warm physiological salt solution. Through the clear solution the movements may be observed or they may be photographed with the moving-picture camera. They may be recorded graphically by means of threads running from the intestine to light levers arranged to write on smoked paper.

The purposes of intestinal movements may be summarized as follows: (1) To mix the ingesta with the digestive juices; (2) to bring the products of digestion into contact with the mucous membrane for absorption; (3) to move the ingesta from place to place along the bowel; (4) to expel the residue from the rectum through the anus; and (5) to assist in the flow of blood and lymph through the vessels of the intestinal wall.

Motor Activity of the Small Intestine

At least five kinds of motor activity are recognized in the small intestine.

A Michigan Pair
G. W. Rawson, Detroit, O. W. Shubel, Quincy.

L. W. Goss, O. S. U. (left), and B. H. Edgington, Pathologist, Ohio Agricultural Experiment Station.

Rhythmic Segmentation.—This type of movement is the most common found in the small intestine, at least of the cat and dog. A mass of food lying quietly in a portion of the intestine is, by constrictions at fairly regular intervals along the mass, suddenly cut into small pieces. These are at once cut in two by constrictions near their middle and the adjacent pieces rushed together. Other contractions promptly follow, severing these newly formed segments, and the process is repeated. Both circular and longitudinal muscle coats are involved in rhythmic segmentations. The process may be going on in several places in the small intestine simultaneously. Periods of segmentation frequently last more than half an hour. Rhythmic segmentations are rare in the rabbit.

The purpose of these movements is to mix the food with the digestive secretions and to bring it into better contact with the mucosa for absorption. They probably assist also in the flow of blood and lymph through the bowel. They are non-propulsive movements.

Pendulum Movements.—These are very common in the rabbit and occur to some extent in other animals and in man. They are, as the name implies, swinging or swaying in type. The contents of short loops of intestine are thrown from one end to the other. At times the intestine seems to slip over the ingesta, which remain more or less stationary. This is a local, non-propulsive type of movement.

Peristaltic Rushes.—These begin as rings of contraction which rapidly widen posteriorly so that a considerable length of intestine undergoes contraction. Both muscle coats are involved. At any point the bowel may remain contracted for from 10 to 25 seconds. Following the wave of contraction there is a wave of relaxation running in the same direction, the intestine remaining flaccid for some time after its passage.

The peristaltic rush is the main propulsive type of movement. The wave of contraction sweeps ahead of it a column of ingesta whose length is ordinarily about 36cm and whose rate of travel averages about 6cm a second. The ingesta may be carried 60 to 150cm along the bowel (rabbit). At times the rush passes over its load and leaves it behind.

Peristaltic rushes may begin anywhere in the bowel and may run short or long distances down it. Pressure changes in the bowel, even slight, may give rise to a rush. Wherever the pressure changes are most effective a peristaltic rush will begin. Pressure changes due to the presence of ingesta in the bowel would be the usual way of giving origin to a rush. As would be expected, many of the rushes begin in the duodenum. Most of the rushes in the small intestine of the rabbit disappear in the ileum, but some may go on to the colon, frequently in passing giving rise to contractions of the cecum. Those that stop in the ileum either fade out or are blocked by strong increases of tonus. Doubtless the stopping of peristaltic rushes is an important function of the ileo-cecal sphincter.

Probably the best explanation as to why peristaltic rushes go down the bowel and not up is the presence of gradients in the wall of the intestine. Thus down gradients of irritability, tone, rhythmicity, latent period, metabolic rate, etc., have been demonstrated in the intestine. These gradients may be

upset under certain conditions, as Alvarez has shown. This investigator has made considerable progress in interpreting certain gastro-intestinal disorders in man in terms of upset gradients, and it is likely that some of these ideas could be extended to include animals.

Tonus Waves.—These are slow changes in the length of the muscle fibers of the intestinal wall. They may involve either muscle coat, and may exist alone or show superimposed rhythmic contractions. They are believed to be concerned in the starting and stopping of peristaltic rushes.

Antiperistalsis.—This is a peristalsis in the reverse or oral direction, and is now thought to be possible anywhere in the gastro-intestinal tract. It is of course neither so widespread nor so powerful as peristalsis in the aboral direction. Probably it is not normally a prominent type of movement in the small intestine.

Motor Activity of the Large Intestine

Broadly speaking, movements of the large intestine are more sluggish than those of the small. This harmonizes with its function as a fecal reservoir or as a place for prolonged bacterial attack on cellulose and other substances (herbivores).

Colon.—This organ shows at least three kinds of motor activity: peristalsis, reverse peristalsis, and contractions of the haustra, or sacculations. Peristalsis may occur anywhere in the colon. Its purpose is to carry ingesta down the bowel. Reverse peristalsis is described as a normal feature of colonic activity in many species. The large intestine of non-ruminant herbivores and of omnivores is sacculated, whereas that of carnivores and of ruminants is not. These sacculations are the seat of active contractions whose purpose seems to be to mix and churn the ingesta. They show some resemblance to the pendulum movements of the small intestine.

Cecum.—Of small size in carnivores and man, the cecum attains enormous development in herbivores, especially those possessing a simple stomach (horse, rabbit, guinea pig). On the whole, cecal movements have not been extensively studied. In herbivores the movements are often sluggish, in keeping with the storage function of the cecum. Nevertheless at times they may be powerful.

Nervous Regulation of Intestinal Motility

Movements of the intestine, like those of the stomach, are fundamentally automatic; i.e., they can take place in the absence of nervous regulation. This is proved by cutting all nerves to the intestine, whereupon the movements continue. Notwithstanding this fundamental automaticity, the intestine is subject to the regulatory influence of the nervous system. The nerve supply of the small intestine is derived from the vagi, which are mainly motor, and the splanchnics, which are mainly inhibitory. The large intestine receives motor innervation by way of the nervi erigentes and inhibitory innervation by way of sympathetic pathways derived from the lumbar cord.

Zusammenfassung

Die Bedeutung des Speichels für die Verdaung der Stärke, die Ursachen des Erbrechens und des Regurgitierens, die Funktion der Oesophagusrinne, und die verschiedenen Arten der Darmbewegung werden einer übersichtlichen Besprechung unterzogen.

References

Much of the foregoing discussion is based on various sections of the part on "Digestion and Absorption" in the writer's book, "The Physiology of Domestic Animals," 1933. Those who wish to examine the original literature will find of value the numerous references given in that part.

Clinic Building, Division of Veterinary Science, Michigan State College.

The Author

Veterinary Service in Rural Public Health*

By WARD GILTNER, East Lansing, Michigan.
Dean, Division of Veterinary Science, Michigan State College.

THAT the public health program in the United States has borne an abundance of good fruit is both statistically susceptible of proof and also generally admitted. That rural communities have profited less than urban communities by the public health movement is likewise acknowledged. Furthermore it is easy to demonstrate that the reason for failure of rural communities to profit by the newer knowledge of public health measures, lies in the fact that they have failed to avail themselves of modern public health service. The veterinarian has in the past and is now demonstrating his capacity to function as a public health officer, both as an executive and as a specialist or technically trained man. It is obvious that certain phases of public health work can be done effectively only by the trained veterinarian. We may well ask ourselves a few questions concerning the rôle that the veterinarian can and should play in the complete, rural, public health program.

1. What is the responsibility of the veterinarian in rural communities for public health? In this connection some generalizations are pertinent. The veterinarian is, as a licensed medical practitioner, ipso facto, a semi-public official serving in a quasi-judicial position in his community. He is educated in large part at public expense and legally licensed to perform certain acts which all others are denied the right to perform. In return he assumes certain legal and social responsibilities. He should ideally, upon announcing himself as a practitioner, voluntarily assume certain responsibilities in the way of rendering aid to the lower animals in the field of curative medicine, surgery and preventive medicine; and he must legally assume certain responsibilities for reporting to the public health officials and assisting them in the suppression of dangerous communicable live stock diseases, some of which are communicable to man. Furthermore, as a man thoroughly trained in the medical sciences, perhaps in some instances better trained than his colleague in human medicine, he bears a burden of social responsibility that makes it incumbent upon him to render to his community every service for which he is trained, whereby his community may become a safer place in which men, women, and children may live and grow.

2. Does the training of the veterinarian fit him peculiarly for protecting the health of the public in rural communities? The answer is emphatically and unhesitatingly, yes. It has been my experience that as a professional group, veterinarians are superior in respect to the elemental virtues—honesty, industry, sobriety, loyalty, patriotism, generosity and manifestation of a wholehearted spirit of cooperation, public service, initiative, and general social service. The veterinarian in his community should never undertake to perform the functions of other professions than his own. He should not treat the human animal medically or surgically, nor should he serve as a legal, spiritual or economic adviser, ama-

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

teur or expert. He should engage in such social activities as mutually benefit the community and himself. However, he would be wise if he refrained from letting the right hand of his professional self know what the left hand of his social self was doing. Medicine does not mix well with anything except more medicine.

I BELIEVE that the outstanding public health service the veterinarian can render his community is the one for which he is primarily trained—the veterinary service. Especially in a rural community, the veterinary practitioner should equip himself and be prepared to engage in a general practice. He should do all the veterinary work in his community, for if he doesn't someone less qualified will do it, or it will not be done. The "horse doctor" has severe limitations in the modern rural community. Veterinary practice is not properly built upon love of horses and contempt for hens, but upon an understanding of the lower animals in health and disease and a willingness and ability to translate that understanding into service.

ONE OF the greatest of modern sanitarians has said that human tuberculosis is an economic problem—that the solution of the problem is a living wage. All human health problems are in a large part economic. It is the function of the veterinarian to conserve and promote human welfare by helping to effect recovery in sick animals having economic value or to prevent disease in them. Many a hog-cholera outbreak has meant the deprivation of some family of the necessities of life. There is also a psychological side to human well-being. Assisting in the restoration of health of a pet dog or cat may prove to be the most potent therapeutic agent for a bedridden owner.

IT IS obvious that the veterinarian alone is trained to control, prevent, and eradicate animal diseases of economic importance. Upon him rests the burden and the responsibility of protecting man from all those diseases that are communicable from the lower animals to man. He alone is adequately trained in food hygiene and inspection, especially in meat inspection and to an increasing degree, in milk inspection. Only the sanitary engineer can compete with him in fitness for the other duties of the sanitary inspector, and only the physician is better qualified in the field of epidemiology. For the educational or propaganda duties of public health work and for its administrative side, the veterinarian is as apt to possess the qualifications requisite as are the members of the medical or any other professional or non-professional group, aside from the public health group itself. Whether the public would look with favor upon the veterinarian in the rôle of sanitarian and health officer, either official or unofficial, I of course cannot predict. Certainly the veterinarian will not be sought out and forced to assume this rôle, but he may assume it and play it creditably if he chooses to make the effort.*

3. Can the veterinary practitioner afford to function conspicuously in the protection of the health of rural people? The answer to this question will depend a great deal on who answers it. Extremists might say that he cannot afford to or that he cannot afford not to, that it is none of his business or that it is peculiarly his business. While self-preservation is the first law of nature, an intelligent interpretation of this law recognizes that preserving oneself involves controlling one's environment. The environment of the country veterinarian is his community, of which the people are the most important part. He must identify himself with the community and its activities. If he is no good as a veterinarian he can scarcely hope to inspire confidence as a Moses, in the relations of public health. If he is, in the vernacular of the South, a "no account" man he won't be able to serve his community in any capacity. His first business is to establish himself as a successful

*According to *Public Health Reports*, U. S. Public Health Service, 49, Sept. 28, 1934, all the whole time public health officers in the United States held M.D. degrees except two, one D.D.S. and one M.S. No one is listed with a D.V.M. degree, although a few years ago there were three, one city and two county health officers.

From East Lansing, Mich.
E. K. Sales, M. A. C., and J. W. Patton, bio-chemist.

practitioner of his art and as a scientifically trained worker. He may then, and he should then, plan how he may function in accessory capacities. If his community needs his services he cannot afford to refuse a position on the board of health, as health officer, meat or milk inspector, sanitary inspector, or any other position for which he is qualified and the duties of which do not render him less efficient in his practice. If necessary a veterinary assistant should be employed by the veterinary practitioner, in order that he may serve his community in ways for which he is better qualified than are his colleagues in other professions.

The veterinarian can afford to identify himself with community pubilc health activities because they are germane to his essential occupation. He should take to them as a duck takes to water, not to keep someone else out of the water, not to pollute the water, but as a matter of course—a natural procedure.

According to *Public Health Reports* 46, December 18, 1931, of the whole time county health officers in the United States there was one with the D.V.M. degree and one D.D.S. The others were M.D.'s. In the December 4, 1931, issue of the same journal we find listed as serving in municipal (in cities over 10,000) executive or administrative positions in public health, 19 with veterinary degrees (D.V.M., D.V.S., M.D.C., M.D.V., one also having an M.D., and one Ph.g. and D.O.) as follows:

2 directors of sanitation or sanitary inspector
1 director of milk and meat inspector
6 health officers or commissioners (or registrar, secretary)
3 director superintendents or deputy commissioners of food inspection
1 director of serological laboratory
4 chief of bureau of dairy products or city agent or city health officer and milk inspector
1 director of bureau of meat inspector

The training of all these health officials is indicated in the following table:

M.D.	779	Ph.G.	7	L.L.B. or B.L.	2
D.V.M.†	20	D.D.S.	6	B.S. in Bacty	1
Dr.P.H.**	15	S.E., C.E. S.B. in E...	5	No degree	220
C.P.H.	14	Ph.D.	3		
R. N. P.H.N.	9	D.O.	2		
M.S.P.H.		B.S.Chem.			
M.P.H.	7	Ph.C.	2		

In the same issue of the *Public Health Reports* we find listed as serving in state and insular departments of health the following veterinarians:

2 Dairy inspectors
2 Serologists
1 Chief food inspector
1 Bureau of Animal Industry
1 State Sanitary inspector
1 on Board of Health

Full time employes had the following degrees:

M.D.	279	Law	4
R.N.	38	M.P.H.	3
Engr.	36	Ch.E.	1
D.P.H.	15	B.S. in Agr.	1
C.P.H.	15	Ph.g.	1
Ph.D.	11	Ph.C.	1
D.D.S.	9	P.A.	1
D.V.M.	7	No degree	217

Probably most of those listed as having no degree actually had some degree other than in medicine or veterinary medicine.

†or other veterinary degrees.
**or D.P.H. which may mean Doctor or diploma in public health.

It should be kept in mind that these data refer only to state and insular health officers and those in cities of over 10,000 population. They do not give us a full picture of the situation since they do not include employes in subordinate positions. Perhaps the veterinarian might make a better showing in this latter group. So far as the rural sections are concerned—in cities, villages, and towns of less than 10,000 and in the open country—we have no reliable source of information relative to the rôle played by the veterinarian or any of the other professional groups or the non-professionals either. Of course it is with the rural sections that this paper deals.

The present status of county health units in the ten states having veterinary colleges, and changes, increases or decreases in the number of such units in five years is shown in the following:

	1933	Change in 5 years		*Per Cent
Alabama	46	1931	54	76.5
Ohio	40	1931	46	55.
Michigan	30	1930	4	32.8
Texas	8	1930	6	6.3
Washington	8	Same for 5 years		44.6
New York	5	1930	4	14.6
Kansas	4	1931	12	6.2
Pennsylvania	3	Same for 4 years		12.3
Iowa	1	1931	2	1.5
Colorado	0	1930-32	1	0
Total	145		140	

It will be noted that while there is a gain of five County Health Units in these ten states the number of such units has decreased in five and increased in only four states since 1930.

4. In what ways can the veterinarian function to assist in protecting and promoting the health of rural communities? It is probable that it is only in rural communities that the veterinarian will have an opportunity to play the leading part in the battle against the enemies of public health. In the larger centers of population—I hesitate to place any numerical limits—the veterinarian should insist that meat inspection is his peculiar domain, that he is probably better qualified for milk and dairy inspection than is the representative of any other profession, that he is competent as a food inspector and as a laboratorian, and that he can lay some claim to qualifications as a general sanitarian. If he wishes to take the position of leadership in the public health service he should take post-graduate work in a school of public health. For those who contemplate a career in public health administration I would not recommend veterinary medicine as the basic training, but rather human medicine. However, the veterinarian need not feel that he is absolutely excluded from leadership in a public health career.

*Percentage of rural population with local health service under whole-time health officers.

IN RURAL communities the veterinarian should establish himself as a competent veterinary medical practitioner, fully serving his community. He should undertake to equip himself to apply all the tests and treatments that science has made available to medicine. If he is to enter the broad field of human service through public health activities, he must first demonstrate not only that he has the training and the equipment to serve, but that he is better trained and equipped than his colleague in human medicine. The deciding factor in determining whether the veterinarian shall take the lead will probably be his personality. It would be a great mutual service to humanity and to the veterinarian if all prejudice toward the veterinarian as a competent medical man might be removed. However, I do not visualize the veterinarian as the inheritor of the overwhelming control of rural public health work. He should always do those jobs for which he alone is trained and he should offer strong competition for those for which he is as well qualified as are the members of other professions.

THE GREATEST service the veterinarian can render his community and the one of which the community will be deprived in the absence of the veterinary effort, is the protection of public health against animal diseases transmissible to man. The veterinarian must concern himself not only with the treatment and prevention of animal diseases, but also with the protection of human health when it is

menaced by these diseases. He has a duty to inform himself fully as to the relationship of the animal and the human disease and without ever encroaching upon the prerogatives of the physician, to take such steps as will prevent the spread of the disease from animal to man or advise as to the available treatment where man has contracted the disease. The technic in these cases may be delicate and may demand an exhibition of the highest type of professional skill and courtesy, but the duty of the veterinarian is clear.

IT WOULD require a volume to relate the rôle of the veterinarian as a custodian of the health of man in his own peculiar field. He need offer no apology for the way in which he has thus far acquitted himself, but he must be alert to detect all cases that concern him as a professional man either as a private practitioner or as a semi-public official. The recital of a few cases will serve to indicate the field. Is not the case of milk sickness a beautiful example of a poisonous plant menace directly to the dairy cow and indirectly to man, the milk drinker, and one in which the responsibility of the veterinarian is clear? Does it not suggest to the veterinarian that he must know all about milk in its relation to human health and that he must put into practice what he knows? And does it not clearly indicate that upon the veterinarian rests a responsibility for the health of not only the people of his own community, but also of distant communities, in these days of rapid transportation of dairy products.

THE PART that the veterinarian has played, is now playing, and must forever continue to play in protecting the public health against bovine tuberculosis is too well known by the medical profession and the laity to necessitate discussion at this time. Already the practical elimination of a deadly or deforming human pathogen, of animal origin, from 18 states, illustrates clearly that the veterinarian not only occupies a place of strategic importance as a guardian of human health, but that he is exceptionally competent to perform his duty. We now have an opportunity to again cross swords with another enemy of mankind, brucellosis of cattle and swine and probably other lower animals. Just what our strategy shall or should be must be discussed on some other occasion. I commend brucellosis to every veterinarian as a disease of animals communicable to man and one that should be mastered with respect to all its manifestations. In the words of Charles Nicolle: "Mediterranean fever is in the course of evolution, and is tending to become chronic. It is a malady which on account of its manifestations and chronicity, will become one of the commonest and most stubborn diseases. . . . Mediterranean fever is a disease of the future."

I trust that I am not rash in predicting that streptococcic mastitis is today a more important disease of cattle than is either tuberculosis or brucellosis, both in respect to its wide-spread occurrence and dangerour effects on the cow and in respect to its public health implications. Again I must reserve the pursuit of this particularly fascinating subject to another time, but not until I have registered my convictions that the veterinarian must take upon himself the burden of saving the cow and protecting human health from the intercommunicable streptococci. These are problems that involve the investigator, the teacher, and the practitioner.

IN TIMES gone by the veterinarian has demonstrated that he could wipe out such hideous human menaces as glanders. He has demonstrated the innocuousness for man of many animal plagues such as Texas fever and hog cholera. He has proved himself an effective researcher, a good pedagog and a preeminently practical man; now let him follow up his victories with still more conquests. Let him not only finish the fight against tuberculosis but decide upon the campaign against brucellosis and streptococcic mastitis. Let him demonstrate in his attitude toward rabies that he is the best friend of both the dog and his master. Let him take cognizance of every new situation

that appears. Who but the veterinarian can warn against the dangers to man of swine erysipelas, one of the newcomers, or of ringworm, an oldtimer. The only protection man can hope for against salmonellosis or food poisoning lies in the vigilance of the trained veterinarian. There is some reason to fear that man may be susceptible to the salmonella of all the domesticated animals, including birds. Who has a better opportunity to warn against and advise with respect to trichiniasis and tapeworm infestations than the practicing veterinarian. Psittacosis, parrot fever, is a veterinary problem. Bubonic plague, typhus fever and Rocky Mountain spotted fever are human threats that should vitally concern the veterinarian. Is it too much to hope for that researches with dog distempter and animal neoplasms may furnish solutions to the virus diseases and cancer of man?

The veterinarian should see to it that his community, no matter how sparsely populated, enjoys the security that comes from adequate meat and milk inspection. He alone can do this and fortunately, in doing it, he serves everyone. The consumer is protected and everyone is a consumer including the producer. But the producer is doubly benefited since in addition to the safeguarding of his own health he is placed in a favored position by the protection accruing to the health of his stock and by the enhanced value of his product due to the stamp of governmental approval and the consequent public confidence in his product.

BY WHAT procedure a veterinarian can best identify himself as custodian of the meat, milk and food supply of a community, I am not qualified to state in explicit terms. However, I can tell the undergraduate veterinary student that there are few jobs to be filled in this field, but there are innumerable jobs to be created. One can picture the federal government creating a great meat inspection service with hundreds of positions to be filled by graduate veterinarians, but I cannot picture any such wholesale creation of jobs for veterinarians

J. D. Grossman (left), and Walter R. Krill, O. S. U., Columbus, O.

in the thousands of rural communities of the different states. It is better that this is the case. The veterinarian must carve out his own place in his community. He should have the backing of his profession, of the veterinary colleges, and of the general public. He will get the support of the public only if, when, and as he makes good in a conspicuous way and as he does get public support it will be correspondingly easier for other veterinarians to enter the public health field.

One of the first things a young practitioner should do is to find out what technical aids are available to him in his community. He should make use of his state educational and experimental facilities, and those of other states and the federal government; but he is passing up a wonderful opportunity if he does not exhaust the possibilities of the local community. He will probably be unable to equip much of a laboratory at his own expense and he may not own a microscope for some years, but he can find out if there is one in the local high school. He may be able to cooperate with the local physicians in his efforts to do laboratory work. These efforts if well directed should have considerable advertising value and are certainly among the best approaches to the public health field. Making

an intradermal test for tuberculosis seems to be a perfectly natural and indigenous task for the veterinarian. To my mind it is inherently just as much the practitioner's business to make an agglutination test for Bang's disease, using Huddleson's rapid plate method, or to make a microscopic diagnosis of infectious mastitis according to the technic described by Bryan, as it is to make a tuberculin test. Many equally impressive examples might be given in the realm of medical chemistry, bacteriology, and pathology. If a veterinarian says that these things do not interest him, then I should say that the public health field will not be attractive to him and he would be of little service in that field. But if he is willing to develop along such lines he may find himself literally forced into public health service where he should be as much at home as is the physician. In a narrow sense a physician is interested in human disease not human health. Certainly a veterinarian has only an academic interest in human disease but a deep and abiding interest in human health.

Is the modern veterinary education training its students adequately to do good laboratory work? I think an affirmative answer is justifiable. So far as the offerings of the curriculum and advanced elective courses are concerned the veterinary student is not being neglected. I do not hesitate to assert that on the whole the veterinary student is more responsive to scientific training than are most other students. The veterinarian should be a good laboratorian. He should be able to do all the laboratory work required of a public health laboratory.

I appreciate that I have at most only opened up the subject of veterinary science in rural public health. I shall be interested in the development of the subject by others. If any of you develop a practical interest in the subject you owe it to the profession to record your experiences so that they may be available to all. It may be safe and pertinent for me to state for such persons, that graduate work in schools of public health would be worth while and that you would be welcomed in such schools. Veterinary colleges should continue to teach veterinary science and medicine.

IN CONCLUSION I should like to add that I am not in favor of direct efforts on the part of the veterinarian to advertise himself or his profession. I would not advocate joining a church in order to make business contacts with church people. The purpose of a church is to promote religion not business. I would not advise joining a fraternal organization in order to get the patronage of the brothers, but for the promotion of the ideals of the fraternity. I would not join a dinner club because I might get on more intimate terms with some fellow townsmen who possess influence, but because I craved good fellowship. I would not insinuate myself into the local business enterprises because it would make my position as a veterinarian more conspicuous, but because I believed the enterprise to be a good sound business for myself and my community. I would not enter actively into politics because I was or wanted to be widely and favorably known in the community, but because I sincerely believed that I could render a public service by plunging into a type of work that is reputed to be not infrequently very suggestive of an autopsy in July on an animal dead, lo! these many days. I wouldn't advise a young veterinarian to marry a girl because her father was a big shot or half shot, but because he loved her. And finally, getting back to public health work, I wouldn't expect as a veterinarian to make a great success of it if I played with it as a prop to a feeble veterinary practice, but I would expect to make a success of it if I went into it convinced of my superior training and peculiar ability to render my community a real service.

Zusammenfassung

Est ist die Pflicht des tierärztlichen Praktikers sich der ländlichen gesundheits probleme anzunehmen. Die Möglichkeiten des Tierarztes, die hygienischen Verhältnisse auf dem Lande zu verbessern, werden aufgezählt.

The Present Status of Blood Examinations*

By R. E. NICHOLS Columbus, Ohio
Assistant in Veterinary Surgery, Ohio State University

The Author

The purpose of this discussion is:

I. to review briefly what seems to be the modern conception of the most common formed elements of the blood,
II. to summarize considerable past literature on supposedly normal animals,
III. to mention briefly reports in literature upon physiological phenomena which bring about variations in the so-called "normal" blood picture,
IV. to discuss and compare some of the older and newer methods of technique, and
V. to offer suggestions as to theroutine use and clinical application of blood examinations.

I BELIEVE it is commonly recognized that blood contains the following formed elements:

Red blood cells or erythrocytes,
White blood cells or leucocytes,
Platelets or thrombocytes, and
Blood dust or hemokonia.

The red blood cells of the various domesticated animals are of slightly different size and shape. We are not primarily interested in minor variations in the shape of the normal red blood cells in the various species, except in the chicken, the red blood cells of which are oval and nucleated. On smears the red blood cells of most species of domesticated animals appear as round non-nucleated discs which vary in size in the different species. The following chart gives the approximate average sizes reported in literature:

Cat	5.9 microns
Dog	7.0 microns
Horse	5.7 microns
Pig	6.1 microns
Cattle	5.6 microns
Sheep	5.0 microns
Goat	4.3 microns
Chicken	12.2 x 7.3 microns

To enter into a fairly complete description of the different leucocytes of the various species of domesticated animals would be too time-consuming. Essentially, the cells of various species are similar though they may differ in size, shape, granulation, staining reaction, etc. The *neutrophil* is characterized mainly by its polymorphous nucleus and neutrophilic-staining cytoplasm and granules. The *lymphocyte* is recognized by its relatively large, usually round nucleus and its relatively small amount of cytoplasm, which is acidophilic in varying degrees of intensity. The *monocytes* (large mononuclears and transitionals) are the largest cells of the blood, being often 18 microns in diameter. They are mononuclear and the nucleus, which is usually somewhat reniform, generally is only about one-half the diameter of the cell itself. The cytoplasm takes varying degrees of basophilic stain and may be granulated. The *eosinophil* contains red granules, of varying size and number, as its distinguishing fea-

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

ture. This cell is very similar to the neutrophil in size and shape, except that the nucleus, as a rule, is less segmented. The *basophil* is similar to the eosinophil, except that the granules take the basophilic stain and are usually smaller. After one has accustomed himself to the most important differences between the five major groups of leucocytes, the minor differences of size, shape and staining properties cause no trouble.

To determine the degree of maturity, and in so doing acquire a clearer conception of the condition or state of the blood-forming organs, certain groups of the leucocytes have been sub-classified. Schilling divided the neutrophils into four groups chiefly according to the morphology of the nucleus. The *myelocyte* or youngest cell of his series has a round nucleus with no indentations. The *juvenile* has a nucleus with a small indentation on one side. The *"band"* or *"stab"* has a deeply-indented nucleus which is not segmented. The *mature segmented neutrophil*, as previously described, has a nucleus which is truly segmented; the segments being connected by filaments or strands.

Wiseman (here at Columbus) examined normal and hyperactive lymphatic tissue and reached the decision, that younger lymphocytes possess a greater affinity for basophilic stain. He divided the lymphocytes of man and rabbit into three groups according to the degree of basophilia of the cytoplasm, and found in normal adult human beings and rabbits, that the proportional number in each groups was relatively stable. The same, apparently, applies to the lymphocytes of the dog and the horse, although the deeper-staining forms seem more common in horse blood than in dog blood. It is essential, of course, in classifying cells according to intensity of staining, to examine the smear previous to counting, to determine the relative intensity of the stain of the smear as a whole.

We will not discuss the last two elements of the blood here; namely, platelets and blood dust.

CHART I

Considerable Data on the Blood of Dogs Reported in Literature.

	Average	Number of Counts	Number of Animals	Number of References	Highest Maximum	Highest Average	Lowest Average	Lowest Minimum
Red Cell Count.... (millions)	**7.16**	748	700	75	11.8	8.4	4.2	3.9
White Cell Count.. (thousands)	**11.68**	850	700	71	40.5	38.0	4.0	3.0
Percent of Neutrophils.....	**68.97**	509	457	42	85.0	79.0	49.0	40.0
Percent of Lymphocytes....	**19.94**	385	341	27	51.0	37.0	10.5	5.0
Percent of Monocytes.....	**6.33**	390	356	27	30.0	17.8	1.5	1.0
Percent of Eosinophils.....	**4.94**	470	418	37	28.0	18.6	0.2	0.0
Percent of Basophils.....	**0.66**(S)	132	107	10	4.0	2.4	0.04	0.0
Hemoglobin.....	90-100% (Sahli) or 15.5-17.2 mgm. % (S).							

CHART II

Scarborough's Figures on Some of the Other Domestic Animals.

	Horse	Cow	Pig	Sheep	Cat
Red Cell Count..... (millions per cmm.)	7.8	6.6	6.7	10.0	8.43
White Cell Count.... (thousands per cmm.)	9.26	9.0	15.8	7.8	13.8
Percent of Neutrophils.....	57	42	39	36	57
Percent of Lymphocytes.....	30	55	52	60	32
Percent of Monocytes.....	8.5	5	3.3	6	6
Percent of Eosinophils.....	3.7	8	4.5	2.5	5
Percent of Basophils.....	0.5	0.6	1.2	0.4	0.1
Hemoglobin..... (Percent)	70-95% (Sahli)	60% (Gower-Oliver)	80-90% (Sahli)	85% (Tallqvist)	46-70% (Sahli)

II. THE question of normal standards is a rather dangerous one, the greatest element of danger lying in the fact that any honest and conscientious individual must admit that he does not know what a "normal" individual is. But, we should not use this as an excuse. We should again accept an idea from the medical profession. Through the accumulation of considerable data and history on apparently healthy individuals, they have established a fairly reasonable set of so called "standards," which can be used clinically at least. We should do the same.

CHART III

Volume Percentage of Red Cells.

Species	Volume %	Number of Determinations	Number of Animals
Equine (Neser)			
Clinically healthy	34.0	100	27
Fast Work	38.0	72	10
Slow Work or Pastured	34.0	156	18
Stabled	26.0	38	11
Mares with or in Foal	35.0	31	6
Foals	36.0	38	6
Bovine (Canham)			
Males			
Birth to 14 mos.	34.0	....	(73)
14 mos. to 3 yrs.	35.0	....	(12)
Oxen	35.0	....	(43)
Females			
Birth to 14 mos.	35.0	....	(111)
14 mos. to 3 yrs.	34.0	....	(14)
Adult Dairy	32.0	....	....
Veld Cows	29.0	....	(27)
Canine			
Young	48.0	175	93

III. REPORTS in literature on so called "normal" standards are obviously not sufficient. We know very little about physiological phenomena which cause variations in the blood picture. The following are a few things we know (Scarborough—Dog):

Physiological Variations of the Red Cells

The dog is an animal subject to a large number of diseases, and frequently harbors intestinal parasites. There are considerable differences in the blood findings in apparently healthy animals. Klieneberger and Carl find a variation of 33% in the red cells, of 50% in hemoglobin, and of 100% in the white cells.

Age.—The number of erythrocytes increases slightly with age until adult life is reached. Stoltzing finds the red count to be 1.5 million higher in adults than in pups a few weeks old. Stockman and Greig found an even greater difference.

Sex.—The male has a somewhat higher number of red cells than has the female (Otto, Holz, and Lyon). Kuhl found slightly higher counts in the females in ten animals examined.

Alimentation.—This has no noticeable effect on the erythrocytic content of the blood of dogs. A moderately long period of starvation may cause the count to increase by 500,000 (Nelson).

Environment.—Dogs are not as susceptible as are rabbits to environmental conditions, but poor hygienic conditions undoubtedly influence the erythrocytic count to some extent.

Breed.—There is a tendency to anemia in dogs of improved and delicate breeds (Friedberger and Fröhner).

Emotional Stimuli.—Fright, pain, etc., will cause a slight increase in the number of red cells.

Pregnancy.—This causes a slight diminution in the number of normocytes (Welcker).

Castration.—This operation is without influence on the number of red blood cells (Lutje).

Asphyxia.—Any type of asphyxia, high altitudes, exercise, etc., will cause a slight increase in the number of red cells.

Anesthetization.—Etherization properly performed does not raise the erythrocyte count (Mann, Lamson), but some struggling is almost unavoidable and Lamson found, in 12 cases, an increase of 1.3 million red cells following etherization.

Physiological Variations in the White Count

There is variability in the white count in apparently normal animals amounting to as much as 100%, at times.

Age.—In young pups a few weeks old the total leucocytic count is approximately double that in the normal adult. There is a greater proportion of lymphocytes and fewer polymorphonuclears. Only Corsy maintains that the number of lymphocytes is relatively less and the number of polymorphonuclears relatively greater than in the adult.

Sex.—Kuhl found that males have a higher total leucocytic count (2,000-4,000) than in females, with similar differential counts.

Pregnancy.—Corsy and Meyer have both found a slight increase in lymphocytes with a

corresponding decrease in polymorphonuclears in pregnant dogs.

Breed.—There is no essential difference, either in total or differential counts in dogs of various breeds.

Alimentation.—There is a definite digestive leucocytosis in dogs. Goodall has found a fairly regular rise in the total number of leucocytes to a maximum at four hours after feeding, with an increase in the relative number of lymphocytes. Pohl considers the maximum to be reached three hours after feeding, when an increase of 78% has occurred. Schultz finds a rise of from 100 to 150% in 45 minutes and lasting several hours. Nicholas and Cot note a slight lymphocytosis in digestive leucocytosis. Corsy states that there is sometimes a slight polynucleosis, sometimes a slight mononucleosis. The return to normal is gradual requiring several hours.

Anesthetization.—Mann has made a complete and careful study of the effects of ether anesthesia on the blood of dogs. He considers that although the preliminary excitement, struggling, and asphyxia have an effect in raising the leucocyte count in anesthesia, there is, nevertheless, a definite etherization leucocytosis which may begin within one-half to four hours. The increase may be slight, but usually by the end of the fourth hour the number has doubled. Usually following etherization, a decrease does not begin for several hours, and the count is still above normal twenty-four hours after.

There may be an actual increase of all types of leucocytes, but the polymorphonuclears are usually the only form showing a relative increase. The lymphocytes are decreased relatively.

Physiological Variations in Hemoglobin

The percentage of hemoglobin is considerably lower in pups than in adults. There is some diminution also in old age. (Paton and Goodall, Stockmen and Greig, Bucalossi.) No conclusions can be reached about the differences in the sexes, since Otto reports higher percentages in males, while Kuhl found the female to have more hemoglobin than the male.

A great deal more work needs to be done before we will have a fairly complete set of standards for clinical use. We must be more careful in reporting our work to include a complete history of each sample examined, including also the technique used.

IV.

REPORTS in literature on so-called "normal" blood are, for the most part, very indefinite as to the technique used. Such being the case, comparisons are difficult to make. Most of the reports nevertheless comprise red counts, white counts, hemoglobin determinations and differential counts of leucocytes. As I stated just previously, Klieneberger and Carl claim that there may be as high as 33% physiological variation in the red count, 50% variation in hemoglobin and 100% variation in the white count. Whether physiological variations should be blamed in the entirety for these relatively large fluctuations or not depends considerably upon the viewpoint of the observer. Perhaps some of the responsibility should be placed upon inaccurate technique. The following may constitute sources of error in making counts:

1. Inaccurate collection of the specimen, such as excessive squeezing of the part.
2. Inaccurate dilution.
3. Destruction of erythrocytes after collection of the specimen, by hemolysis due to improperly prepared diluting solutions, use of the wrong diluent, etc.
4. The use of inaccurately calibrated apparatus.
5. Mistakes in making the count, such as counting the same cell twice, not counting all the cells in the ruled area or the counting of dust granules, artefacts, etc.
6. The presence of dirt or molds in the diluting fluid.
7. Dirty apparatus and dirt between cover slip and chamber.
8. Too much of mixture on counting chamber before applying cover slip.
9. Failure to mix properly the cells and diluting solution before counting.
10. Excessive delay before making the mount for counting.
11. Failure to wait for the cells to settle upon the chamber before making the count.
12. Arithmetical mistakes in the calculation.
13. Physiological and other factors influencing the count *per se*.
14. Personal element.

Most of the foregoing factors apply also in making white counts.

Neser of South Africa, working with horse's blood, found a lower percentage of error in determining the volume percentage of red cells than in making red counts. To lower the percentage of error in determining the oxygen-carrying cells here at the clinic, we also have done away with red counts. Since the introduction of Wintrobe's modified hematocrit tube and his simplified method of examining blood, we have done away also with counting white cells and prefer to determine the volume per-

centage of leucocytes. Wintrobe's method embodies the determination of sedimentation rate of cells, volume percentage of red cells, volume percentage of white cells, platelets and icterus index all from the same sample of blood. For clinical use this method is extremely time-saving for many samples may be run at the same time. The sedimentation rate of cells may be determined with the same sample of blood previous to centrifuging for volume percentages. Hemoglobin may be determined and smears counted during the intervals between the sedimentation readings. In toto, this simpler method includes all the requisites of routine clinical examinations of blood; namely, minimal amount of necessary blood, minimal instrumentation, simplicity of technique, minimal of required time, maximal number of specimens possible to examine at the same time, and accuracy.

V. LIKE standards, the use of blood examinations is also a dangerous topic. The modern conception, I believe, is that blood examinations in themselves are not pathognomonic of any pathological condition but in conjunction with complete histories and thorough clinical examinations are of diagnostic and prognostic aid. Their greatest value lies in many repeated examinations of as many constituents of the blood as possible to determine more scientifically and accurately the exact condition of the patient and to follow the course of the pathological process; i. e., to determine whether the animal is improving or not.

In human medicine routine blood examinations in hospitals and in practice have proved, beyond question, their usefulness as aids in the diagnosis of numerous and various puzzling "border-line" conditions as well as aids in the prognosis of these and some of the more easily detected conditions. Literature abounds with reports of individual cases where such examinations have undoubtedly proved extremely valuable, but, what is more important, the greater number of articles are written by directors of hospital laboratories or assistants whose views

Army Veterinarians
Maj. F. L. Holycross and Maj. F. C. Sager.

are primarily the results of routine hospital examinations.

Examples

1. Cutler, J. W. (Henry Phipps Inst.). The Practical Application of the Blood Sedimentation Test in General Medicine. Observations Based Upon About 5000 Patients Over a Period of Six Years. *Amer. Jour. of Med. Sci.* 183:5:643, May, 1932.

2. Hunt, H. F. (Mayo Clinic). Studies of Sedimentation of Erythrocytes. *Jour. Lab. & Clin. Med.* 14:1061, 1928.

3. Eisenberg, A. A., and Nemens, H. S. (Sydenham Hosp.). Value of the Schilling Hemogram in Infections. Preliminary Report on 3500 Cases. *Amer. Jour. of Surg.* 21:1:56 July, 1933.

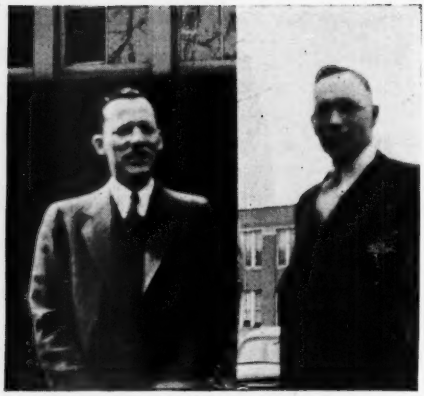
4. Kugel, M. A., and Rosenthal, N. (Mt. Sinai Hospital). Pathological Changes Occurring in Polymorphonuclear Leucocytes During the Progress of Infections. *Amer. Jour. of Med. Sci.* 183:5:657, May, 1932.

5. Wintrobe, M. M. (Johns Hopkins Hospital). Macroscopic Examination of the Blood. Discussion of Its Value and Description of the Use of a Single Instrument for the Determination of Sedimentation Rate, Volume Percentage of Packed Cells, Leucocytes and Platelets, and of Icterus Index. *Amer. Jour. of Med. Sci.* 185:1:58, January, 1933.

6. Wiseman, B. K. (University Hospital, Columbus, Ohio). Criteria of the Age of Lymphocytes in the Peripheral Blood. *Jour. of Exp. Med.* 54:2:271, 1931.

7. Kilduffe, R. A. (Atlantic City Hospital). Clinical Interpretations of Blood Examinations, 1931, Lea & Febriger, Philadelphia, Pa.

The veterinary field, however, presents a different problem. Instead of dealing with the blood of one species, many different varieties of blood must be handled. What



E. E. Sweebe, North Chicago, Ill., and J. H. Lenfesty, Lyons, Ohio.

to consider normal is often perplexing because of the limited published data on apparently healthy animals. Procuring blood in some species of animals is often a problem in itself. But, with the advent of methods applicable to clinics and hospitals, larger numbers of animals can be examined and data accumulated, so that within a few years approximate normals can be obtained as has been for humans. In addition to this, much will be recorded concerning pathological conditions.

In animal practice some fields of hematology have already proved their usefulness. The Whartons (Wharton, D. R. A. and M. W., *Amer. Jour. Hyg.* 19:1:189, January 1934), prefer to define canine distemper by blood alterations, particularly red cell counts, hemoglobin and sugar determinations. They state that unless there is a change in these factors, there is no disease. In some cases of canine distemper the sedimentation rate may be increased even before the initial rise in temperature and presentation of outward manifestations. During the course of the disease repeated blood examinations give a more accurate conception of the patient than temperature or symptoms.

Practical example: Case No. 624 at the Ohio State Veterinary College Clinic, Boston Terrier, three months of age. History of listlessness and slight loss of appetite. Physical examination revealed a mild serous eye and nose discharge and a temperature of 103° F. A typical "border-line" case where one is not sure whether to administer serum or not. A blood examination was made which revealed a rapid sedimentation rate and anemia indicating infection.

In view of this additional knowledge the advisability of administering serum was more justified. The animal received serum therapy and returned home in ten days apparently normal again.

In differentiating malignant from benign new-growths the sedimentation test has proved to be of value.

Practical example: Case No. 1769, horse. Growth on penis. A blood examination revealed a rapid sedimentation rate indicating malignancy. With this additional information one could advise the owner more specifically as to the seriousness of the case.

In infections the use of the total and differential leucocyte counts has proved of aid.

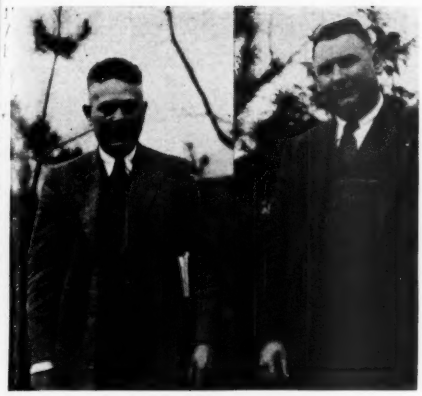
Practical example: Case No. 641, German shepard, eight months of age. Canine distemper and complications. During the first four days blood samples showed a total white count of from 17,000 to 26,000 with neutrophils between 76 and 86 per cent and young forms decreased. The temperature had been varying between 103.8° and 105.8° F. On the fifth day the temperature dropped to 102.6° F. The following leucocytic picture presented itself; total white count—75,000; neutrophils—97 per cent; young forms decreased. This led to a diagnosis of sepsis. The animal died that night.

Often the percentage of eosinophils is a better indicator of the presence of parasites than fecal examinations, especially in cases of parasitism in which eggs are not found in the feces.

Practical example: Case No. 1541, dog, eight months of age. Three successive fecal examinations were negative. No tapeworm segments were found on the hair about the anus. Blood examinations revealed a persistent high percentage of eosinophils. The animal was given arecolin orally and passed several tapeworms.

The presence of high eosinophil counts, when fecal examinations are negative, indicates that other methods of detecting parasitism should be resorted to.

One could ramble on indefinitely upon the assistance to diagnosis and prognosis that hematological examinations yield, but, what is to be stressed in particular, is the fact that routine procedures *can* be effectively carried out in conjunction with clinical examinations and rightfully *should* be so carried out.



SUPERSALESMEN
J. C. Schoenlaub, Indianapolis
H. M. Bonifield, Warren, Ind.

ROUTINE TECHNIQUE

1. Place nearby three clean slides and blood bottle containing citrate or oxalate.
2. Disinfect area.
3. Withdraw 5cc of blood into a clean, *dry* glass syringe. It is important to work fast to prevent clotting.
4. Deposit one *small* drop (free from bubbles) near the end of each of two of the slides.
5. Give the syringe to an assistant and with the third slide make the films by the "drag" method. Use one end of the third slide for one film and the other end for the second film.
6. In the meantime the assistant will transfer the remaining blood into the blood bottle, will cork and shake it for a minute or two. While he is shaking it he will rinse the syringe and needle in cold water or place in a dish containing cold water. If one works quickly an assistant is not needed.
7. While the smears are drying, fill the Wintrobe modified hematocrit tube to the "10" mark. Using a 6 in. needle and dry glass syringe (or the glass pipette furnished), draw up about 2cc of blood from the blood bottle. Be sure that no bubbles are present in the needle. Insert needle to the bottom of the hematocrit tube and carefully fill the tube as the needle is slowly withdrawn. If the point of the needle is kept just below the surface of the blood, no bubbles will form in the tube. If bubbles are present in the tube, withdraw all of the blood and refill the tube.
8. Set the filled tube in a quiet place and observe the sedimentation rate, recording the time the tube is filled and the column of cells one-half hour and one hour after filling. Record the last two on the chart.
9. Make hemoglobin determinations, set up new samples and, if need be, stain and examine smears during the intervals between the readings of the S. R.
10. After the hour reading, place tube in rubber-cushioned centrifuge tube holder. Be sure that the opposite holder weighs exactly the same. Centrifuge at high sped until the reading of the cell column remains the same after repeating centrifugalization, i. e., until the cells will pack no more (3000 r.p.m., ½ hour).
11. Read the total column of cells, column of red cells and column of white cells (on top of red cells). Record on chart.

NORMAL S. R.

Dog—approximately 98 to 99% of cells at 1 hour.

Horse (artillery)—approximately 50 to 70% of cells at ½ hour; 42 to 60% of cells at 1 hour.

Zusammenfassung

Es werden, auf grund der amerikanischen Literatur, die wichtigeren Blutbestandteile besprochen. Die Lymphozyten der Haustiere lassen sich, nach dem Grade ihrer Affinität für basophile Farben, in drei Gruppen einteilen. Weiterhin werden die in der Literatur enthaltenen Normen und die physiologischen Schwankungen besprochen. Für die Erzielung einer einheitlichen Technik der Blutuntersuchung wird die Anwendung der modifizierten Hematokrit-Röhre nach Wintrobe empfohlen. Diese Methode erlaubt die Errechnung der Senkungsgeschwindigkeit, des Volumens der roten und weissen Blutkörperchen, der Anzahl der Blutplättchen, und des Färbeindexes von ein und derselben Blutprobe. Die Vorteile einer Auswertung der Blutbefunde für die Klinik werden angedentet.

References

Schilling, V.—quoted by Kilduffe, R.A., The Clinical Interpretation of Blood Examinations, 1931, Lea and Febiger, Philadelphia, p. 274.

Wiseman, B. K.—quoted previously under Section V.

Scarborough, R. A.—The Blood Picture of Normal Laboratory Animals, Yale Jour. of Biol. and Med. *3*:63, 169, 267, 359, 431, 547, *4*:69, 199, 323.

Neser, C. P.—The Blood of Equines, 9th and 10th Rept. of the Dir. of Vet. Educ. and Res., Dept. of Agri., Union of S. Africa, April, 1923, p. 479.

Canham, A. S.—The Blood of Cattle, 16th Rept. of the Dir. of Vet. Educ. and Anim. Ind., Union of S. Africa, August, 1930, p. 531.

Wintrobe, M. M.—quoted previously in Section V.

Nutrition in Relation to Animal Health*

By R. M. BETHKE,
Ohio Agricultural Experiment Station
Wooster, Ohio

IN the last twenty years there have been rapid developments in our knowledge of animal nutrition. This knowledge continues to accumulate at an increasing rate. It has such a direct and important bearing on the prevention and cure of disease that nutrition may now be regarded as a new branch of medical science.

During the latter part of the last century and even well into the present century it was thought that the chief components of food and feedstuffs were proteins, fats and carbohydrates. Rations were formulated on this principle and were thought to be complete when they contained certain amounts of protein in relation to the energy-yielding substances (fats and carbohydrates). The discussion of rations invariably centered around "nutritive ratios." Very little attention was paid to the matter of minerals, although it was known and recognized that they entered into the make-up of the animal body. Vitamins, or the vitamin theory, were unheard of.

It has been only within the past 20 to 25 years that vitamins and minerals, equally as essential constituents of the ration as are proteins, carbohydrates and fats, have received the attention they warrant. Thus in terms of our present knowledge, an adequate ration is defined as one that contains proper amounts and quality of proteins, sufficient energy-yielding substances (carbohydrates and fats) and all the essential minerals and vitamins to meet the needs of the animal for normal growth, production and reproduction. An inadequate ration is one that is deficient in one or more of these essential feed components.

Since resistance to certain diseases or health is dependent upon good nutrition, it is evident that a deficiency of any of the essential feed components will result in a weakened system and in many instances in specific disease. Although proteins and energy-producing substances (carbohydrates and fats) are essential to growth, production and reproduction, a deficiency or inadequate intake of these organic substances do not manifest themselves in specific symptoms—aside from poor general performance and debility on the part of the animal in question.

Deficiency diseases are primarily of mineral and vitamin origin. These form the basis of my discussion.

Minerals

The animal requires from 12 to 14 mineral elements for its diverse bodily functions. Of this list, special consideration need be given only to sodium, chlorine, calcium, phosphorus, iron, iodine and fluorine. The remaining essential elements are furnished in ample quantities to meet the needs of the body in ordinary feeds. The fact that our management procedures have been changed; that our soils are either deficient in certain mineral elements, or have become depleted from continuous cropping, and that we are imposing increased requirements upon our animals, in the form of accelerated growth, increased milk and egg production, has brought in its wake many mineral problems.

Salt.—The need for additional salt (sodium chloride) in any livestock program is well understood and recognized. Yet there are many feeders who do not appreciate that a deficiency of salt will interfere with the normal performance of the animal. One needs only to consult the work of Babcock, of Wisconsin, or Evvard to have the importance of salt impressed upon one. Evvard speaks of it as "white gold."

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

Calcium and Phosphorus.—The two mineral elements required in the largest amounts by animals and fowls are calcium and phosphorus. That cattle frequently suffer from a deficiency of one or the other of these minerals has been observed many times. Forage crops are a good source of calcium, but only a fair source of phosphorus. Certain forages, however, such as timothy, especially if grown on an acid soil, contain but small amounts of calcium, and if this is fed to cattle with grains and vegetable protein supplements which are generally low in calcium, insufficient calcium will be supplied to meet the needs of the animal. Phosphorus deficiency, aphosphorosis, has been observed in cattle in Michigan, Wisconsin, Minnesota, Kansas, California, Florida, Texas and South Africa. The animals become unthrifty, unproductive and develop depraved appetites. These deficiencies are observed under practical conditions, and are due to the low phosphorus content of the forage—basically to a phosphorus-deficient soil. The condition can be corrected by supplying phosphorus, in the form of bone meal, bran, or by phosphate fertilization of the land to increase the phosphorus content of the forage grown on the soil. At the Michigan station they noted phosphorus deficiency in cattle fed on alfalfa hay, corn silage and corn. The alfalfa hay was low in phosphorus content as is frequently the case. The Michigan results showed that 10 grams of phosphorus per 1,000 pound of live weight were required for maintenance and that 0.75 grams should be added for each pound of milk produced.

Sheep.—Recent work at the Ohio station has shown that calcium and phosphorus may be limiting factors in sheep feeding. This is particularly true in case a poor roughage, like poor-quality timothy hay, is used. Under these conditions, the addition of calcium proved of particular benefit and made the ration almost comparable to one including alfalfa hay, providing enough supplemental protein was added to make the rations comparable. About one-third of an ounce of limestone per head daily was ample to meet the calcium requirements. Phosphorus may be a limiting factor in case a low-phosphorus roughage is fed and the grain and protein allowance is restricted.

Above: Maj. A. C. Wight, Ft. Benjamin Harrison, Ind.; O. Norling-Christensen, Chicago. Below: Wesley O. Keefer, Columbus ("Do you remember?") and C. H. Covault, Iowa State College.

Swine.—Like other stock, swine require calcium and phosphorus. The ration of swine is frequently deficient in both of these minerals—especially calcium—for the reason that grains and grain by-products as well as vegetable protein concentrates are poor sources of calcium. If the ration of the pig is lacking in minerals, improper skeletal development results. The bones are weak and easily broken, and poor growth and feed utilization result. Practical experiments have shown that for best results even rations containing packing house by-products (tankage) or fish meals should be supplemented with additional minerals, such as ground limestone, bone meal, or both.

Poultry.—The chicken has the greatest requirement for calcium of any farm animal. The calcium requirement of the laying hen is greater than that of the dairy cow,

when comparisons are made on equal weight basis. The nature of the average poultry ration makes calcium the first limiting factor. A deficiency of calcium or phosphorus, or both, in case of the chick or laying bird will result in rickets (leg weakness) and poor shell texture.

Although calcium and phosphorus are important elements for proper nutrition, they cannot be added in any amounts and expect maximum results. There is evidence that indicates that some attention must be paid to the calcium-phosphorus relationship or ratio in the feed. This applies particularly to horses, growing chicks, turkeys, pigs, and less to sheep. Cattle, on the contrary, appear to have a greater tolerance in this respect than other domestic animals. Horses fed a ration containing markedly more phosphorus than calcium develop general bone dyscrasias, arthritis, spavin, navicular disease, side-bones and exostoses manifested by lameness, systemic nerve derangement and ultimately, in extreme cases, osteoporosis. In case of chicks or turkeys, a condition of slipped tendon or enlarged hock develops if the ration contains too much phosphorus. In the pig and sheep, inferior growth and poor feed utilization usually result.

Iron.—Deficiencies due to a lack of iron in the ration can and do occur under practical conditions in certain species. The Florida station has reported severe anemia in cattle existing on certain ranges. Investigation has revealed that the soil and forages of these ranges are deficient in iron. In certain foreign countries (New Zealand) a disease known as "bush-sickness" and "coasty" disease due to an iron deficiency is common in cattle. The occurrence of "thumps" in suckling pigs usually farrowed during the very early spring or late winter is rather common. The cause of this condition had in the past been ascribed to many factors, such as lack of sunshine, not coming in contact with the soil, etc. Within the past few years it has been definitely shown that "thumps" or anemia in pigs is due to an iron deficiency and can be prevented, easily, by supplying iron to the suckling pig. Work at Cornell has shown that by dissolving one pound of ferrous sulphate in a quart of water and giving one-third of a teaspoonful per pig per week will prove sufficient, under most conditions, to prevent anemia.

Iodine.—A deficiency of iodine, as is known, manifests itself in enlarged thyroid glands in calves, colts and lambs, and hairlessness in pigs. These conditions are commonly observed in the so-called goiter belt. The condition can be controlled easily by supplying iodine in some form to the dam and to the young animal. Iodine deficiency in poultry has not been observed generally. Presumably, the iodine requirements of this species are either lower than other domestic animals, or the feeds generally used furnish enough iodine to meet the needs of the bird. Fish meals, fish oils, etc., are fair sources of iodine.

Fluorine.—According to some investigators, fluorine is a normal constituent of the skeletal system. While it may be considered to be required for normal nutrition, experimental work has shown, definitely, that too much fluorine proves toxic and further that its effects are accumulative. It especially affects the hard tissues of the body. It causes softening of the teeth and an increase in the size of the bones—especially the jaw and long bones, and a marked decrease in their tensile strength. Birds tolerate fluorine more than other domestic animals, and cattle appear to be more susceptible to an accumulative effect than other species.

Vitamins

Vitamins have been the subject of extensive investigations within the past 20-odd years. Although these researches have proved, definitely, the correctness of the vitamin theory, there are still those in medical and veterinary work who regard it more or less as a "myth" or a "fanciful idea" on the part of certain investigators. Certainly, the more or less specific symptoms or manifestations and tissue changes caused by the lack of vitamins in the ration, and the fact that these substances are being identified as defi-

nite chemical compounds, should leave no doubt in the mind of anyone of the importance and correctness of the "vitamin hypothesis."

At present there are six recognized vitamins—A, B, C, D, E, and G. I shall attempt to discuss them briefly in the order enumerated.

Vitamin A.—This factor is commonly referred to as fat-soluble A or the antiophthalmic vitamin. It also is sometimes referred to as the yellow corn factor. It is present in yellow corn and not in white corn. It is usually associated with a natural yellow color, although there are certain exceptions. Within recent years it has been shown that there are two forms—one colorless and the other colored (deep yellow or orange). Correctly speaking, true vitamin A is colorless, whereas the colored factor, or the substance which animals can convert into vitamin A, is provitamin A, the chemical substance carotene; which is found in green plant tissue, properly cured hays, yellow corn, carrots from which it derived its name, sweet potatoes, etc.

All animal life, so far as we know, requires vitamin A. It concerns the cattleman, swineman, sheepman, poultryman, and no doubt the horseman. A deficiency of this factor manifests itself in poor growth. marked nervous disturbances and changes, more or less definite eye infections and lesions, and an increased susceptibility to respiratory infections.

In case of cattle and probably other animals, it results in reproductive troubles, such as abortion, shy breeding, etc. The California station recently reported severe vitamin A deficiency in range cattle. The owner had lost 100 of a herd of 250 before it was called to the attention of station investigators and the condition was definitely diagnosed. During the past year it was reported that a certain percentage of the drought cattle at the Government feeding station at Delaware, Ohio, showed eye lesions suggestive of a vitamin A deficiency. It is probable that under average conditions we will not run across vitamin A deficiency in cattle. However, under conditions of poor and very limited roughage, such as prevailed in certain sections of the country during the past year, the California observations and those of the dairy cattle investigators of the U. S. Department of Agriculture, warn us we should be on the lookout for it.

The symptoms of vitamin A deficiency in sheep are similar to those in cattle. Likewise, feeding conditions conducive to the development of vitamin A deficiencies in cattle would operate in a similar manner in sheep.

The Kansas and Wisconsin stations have reported on vitamin A deficiency in swine. The animals show an incoordination in gait and go into convulsions when disturbed, due to changes in the nerve tissues. The use of yellow corn in the ration will furnish adequate vitamin A. In case white corn is fed, some source of vitamin A, as good green legume hay or meal, should be included in the ration.

No experimental work on vitamin A deficiency in horses has come to my attention. The appearance of "night blindness" in cattle suffering from vitamin A deficiency makes me wonder whether the same disease in the case of horses might not be associated with inadequate vitamin A intake.

As previously stated, fowl are subject to vitamin A deficiency. Chicks will show a nervous incoordinated gait, ruffled feathers, and sometimes watery eyes. Mature birds invariably develop an infection of the eye, discharge from the nostrils, and general debility. On post-mortem examination, numerous white or yellowish white spots of about the size of a pin head, are observed on the membranes of the gullet; the kidneys are filled with urates. The ureters may be distended to the thickness of a pencil and filled with urates. Frequently the urates may cover the heart and extend over the abdominal tract. The external symptoms in mature birds are similar to occular roup; however, the more or less characteristic occular roup odor is not present in vitamin A deficiency.

Vitamin B.—It is thought that all animals

Friendly Competitors
W. K. York, Indianapolis, and Carl Norden, Lincoln, Nebr.

have need for this factor. In case of ruminants, the factor is synthesized in the rumen —presumably through bacterial action. Swine and poultry require that the vitamin be present in the feed. Fortunately, grains and grain by-products abound in this factor, and since they form the major portion of the ration of pigs and chickens, the requirements are generally met. If, however, degerminated grains were used, vitamin B deficiency would no doubt occur.

Vitamin C.—Ascorbic acid or vitamin C is required in the ration only by man, monkey, and guinea pig. Domestic animals either do not require this vitamin or, what is more probable, are capable of synthesizing it.

Vitamin D.—The sunlight factor or vitamin D is required by all animals, including fowl and man. A deficiency of vitamin D or calcium and phosphorus, or both, in the ration will result in rickets. Fish oils, direct sunlight, ultra-violet light, and viosterol serve as sources of vitamin D.

Experiments at the Wisconsin, Pennsylvania, Michigan and other stations have shown definitely that calves will develop rickets unless some source of vitamin D or ultra-violet light is furnished. Rickets has been observed under practical conditions. While this factor is of importance in a live-stock program, it is probable that the requirements of the animal is met if they are given some exposure to direct sunlight and a sun-cured hay is fed. Pennsylvania was successful in preventing rickets in calves by feeding 2½ pounds of sun-cured alfalfa hay daily, whereas the same amount of machine-cured alfalfa did not prevent rickets. The same conditions in respect to this vitamin apply to sheep.

A number of experiment stations have shown the importance of vitamin D, or sunlight, in pork production. The absence of this factor causes rickets as in other animals. This manifests itself in the form of poor growth, performance, and bone formation. If swine have access to direct sunlight, as in spring and summer, the vitamin D requirements are adequately met. In case of confinement, or during the winter months, it is well to supply the factor, either in the form of fish oils or, as is more generally done, by feeding a sun-cured legume meal or giving the animals access to a good quality sun-cured legume hay.

The deficiency of vitamin D in chickens and turkeys is generally quite well understood. The requirements of fowl are materially greater than those of other domestic animals. The poultryman should utilize sunlight whenever possible. However, during the fall and winter months and whenever his birds are confined, it is essential that he supply vitamin D, in the form of a fish oil or ultra-violet light. The latter, although effective, has not come into extensive practical use.

As previously stated, both vitamin D and the minerals, calcium and phosphorus, must be supplied in order to prevent rachitic symptoms. The mere addition of minerals will not obviate the necessity for some vitamin D.

Vitamin E.—This, the fertility vitamin, is thought to be required by animals. In its absence pathological changes in the reproductive organs of the male and female occur. This factor is widely distributed in nature—grains and grain by-products, particularly the germ, are good sources. It is believed

that the needs for this factor are met when good quality feeds are used.

Vitamin G.—The antipellagric factor, or vitamin G (B_2) is the latest addition to the vitamin family. It has been reported that the absence of this factor was the cause of "black-tongue" in dogs. A very recent report, however, states that vitamin G *per se* is not associated with this disease in dogs. Very little information regarding the importance of this factor in animal nutrition is known. In lieu of its more or less universal presence in roughages, it is doubtful whether it will be a serious factor in case of ruminants. Research at the Ohio and Cornell stations has shown that it is of paramount importance in poultry nutrition. A deficiency of this vitamin manifests itself in form of poor growth, increased mortality and a peculiar leg paralysis in case of chicks and decreased egg production and poor hatchability in the adult fowl. Pellagric symptoms of the feet, mouth, and eyes have also been observed in growing birds. The practical control lies in the liberal use of milk, either liquid or dried, and high-quality legume meals which are good sources of the factor. Liver and yeast are also potent sources. However, their use generally is not practical or economical. Average grades of commercial meat scraps and tankage, certain fish meals, and vegetable protein concentrates are not dependable or good sources of this vitamin.

The absence of this factor is conducive to the development of skin lesions in the rat. Dogs are very susceptible to vitamin G deficiency. In these animals it is responsible for many skin ailments and for lack of growth, increased susceptibility to disease, unthriftiness, etc.

Loss of Carotene in Hay During Storage
(Baled, field cured)

Sample and grade	Carotene content at beginning of period		Carotene content at end of period		Loss of carotene (per cent)
	Date	Mgs. per kgm. air dry	Date	Mgs. per kgm. air dry	
1—Alfalfa #1	3-25-33	37.1	8-29-33	16.0	57
2—Alfalfa #1	11-16-33	121.0	7-25-34	52.1	57
3—Alfalfa #1	2-14-34	32.2	7-26-34	21.0	35
4—Alfalfa #1	1-20-34	30.5	7-16-34	16.7	45
5—Alfalfa #1	3-22-34	38.0	7- 5-34	25.2	34
6—Alfalfa #3	2- 2-34	10.7	7-26-34	7.6	28
7—Timothy #1	3- 1-34	20.4	7-16-34	14.1	31
8—Timothy #2	1- 6-34	9.2	7-16-34	4.5	51
9—Timothy #3	1- 6-34	9.0	7- 5-34	5.0	44

Average Carotene Content of Feeds
(Mgs. per kgm. of feed)

Forage	As consumed	Dry basis
Kentucky blue grass	151	567
Alfalfa, green growing	.....	340
Alfalfa leaf meals	111	115
Alfalfa hay: U. S. #1	45	50
U. S. #2	17	20
U. S. #3	6	7
Timothy hay: U. S. #1	21	23
U. S. #2	9	10
U. S. #3	4	4
Clover hay: U. S. #1	12	13
Carrots (garden)	91	912
Corn silage	10	39
Corn fodder, dry	4	4
Corn, yellow	3	3

Quality in Feeds

Within recent years we have heard considerable discussion about quality in feeds. This not only applies to the quality of proteins, their digestibility, etc., but also to the question of vitamins and minerals. Two feeds may be equal in protein, fat, and carbohydrates but yet differ widely in minerals and particularly in vitamins. This is amply demonstrated by the vitamin A (carotene) content of feeds as affected by cutting, processing, etc. Also, it has been shown that the vitamin G content of forages is dependent upon the time of cutting, method of curing, etc. Certainly, research demonstrates that more information and attention is needed as to the proper methods of making and preserving the various nutritive factors in our feeds.

Zusammenfassung

Die durch das Fehlen von Natrium, Chlor, Calcium, Phosphor, Eisen, Jod, Fluor, und das Fehlen von Vitaminen in den Futtermitteln hervorgerufenen Mangelkrankheiten werden näher beleuchtet.

Reenforcement of Milk With Vitamin D*

By W. E. KRAUSS,
Associate in Dairy Industry,
Ohio Agricultural Experiment Station,
Wooster, Ohio

Vitamin D is known as the antirachitic vitamin because when it is absent from the diet of young animals rickets develops, and when it is added to the diet of animals suffering from rickets, the diseased bones may be healed. Unlike the other vitamins, however, it is not necessary to have vitamin D in the diet to produce an antirachitic effect. Exposure of the skin to ultra-violet light enables the animal body to manufacture vitamin D. For this reason the incidence of rickets has been shown to have both geographical and seasonal distribution, the chief variable in determining this distribution being the amount and intensity of sunshine. Skin pigmentation is also a factor—negro infants are more subject to rickets than are white children.

With the apparent abundance of sunshine in this country one wonders as to the necessity for concern with any dietary source of vitamin D. The late Dr. Alfred F. Hess, one of the greatest authorities on infantile rickets, believed that three-fourths of bottle-fed babies and one-third to one-half of breast-fed infants develop rickets to some degree by the month of March. A more recent estimate (1934) by Dr. D. J. Barnes of Detroit, places the incidence as 50 per cent in bottle-fed infants and 25 per cent in breast-fed infants. While it is true that rickets is not a fatal disease, and most cases of it are so mild as to be unobserved or to heal readily, as soon as the child is exposed to spring sunshine, it is a factor contributing to infant mortality, and affecting adversely the well-being of adolescents and adults.

Tetany and increased susceptibility to infections, particularly of the respiratory tract, may accompany infantile rickets and be the direct cause of death. Dental defects, deformities of the ribs, the spine, the breast bone, the skull and the legs, so often seen in older children and in adults, may be traceable to rickets in infancy. According to Hess, the greatest complication of rickets lies in deformity of the pelvis which may lead in later life to the death of mother or child, especially among negroes. On this point Hess says: "Its importance cannot be emphasized too greatly in appraising the seriousness of rickets and the value and necessity of prophylactic treatment."

It is apparent, then, that in this country rickets has too great an incidence, and that sunshine cannot be depended upon to prevent this disease. It is true that artificial sunlight sources are available, but as yet these are still beyond the reach of most people because of their cost. Some dietary source of vitamin D must, therefore, be had.

UNFORTUNATELY, practically all foods, including milk, are devoid of or contain very little vitamin D. Eggs produced under proper conditions of feeding and management, and certain marine products are fair to good sources of this factor. However, in the quantities in which they are usually eaten by infants these products cannot be classified as antirachitic agents. Cod-liver oil was used in the treatment of rickets many years before its mode of action was known. More recently other fish oils have been shown to have antirachitic properties equal to or greater than those of cod liver oil. In 1924 it was shown that sterol-containing materials, upon exposure to ultra-violet light, take on vitamin D potency. This discovery, together with the development of fish oil concentrates, increased the number of potent antirachitic agents considerably. In spite of this the incidence of rickets is

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

still too high. This may be due to several causes; ignorance, poverty, improper parental supervision and unpleasant sensations produced by the materials and methods of administration. To have available a pleasant, cheap and universal food source of vitamin D that might be an automatic rickets prophylactic, seems, therefore, desirable.

The two universal food articles are bread and milk. Of these, because of the relationship between calcium, phosphorus and vitamin D, because it is one of the best natural food sources of both calcium and phosphorus, and because it is the sole or principal article of diet in infancy, milk seemes to be the one article of food which, if properly fortified with vitamin D, will automatically confer benefit upon the greatest number. Five or six years ago, therefore, steps were taken by various groups of investigators to increase the vitamin D content of milk to the extent that when taken in the usual quantities it would serve as an antirachitic agent.

As a result of both scientific investigation and commercial development there are now three general methods available for materially increasing the vitamin D content of milk on a commercial scale:

1. By feeding irradiated yeast to cows. In this method cows are fed irradiated yeast of guaranteed vitamin D potency, the amount of yeast fed depending upon the production of the cow. Milk so produced is called "Metabolized Vitamin D Milk" and must contain at least 160 Steenbock or 432 U.S.P. units of vitamin D per quart.

2. By irradiating milk with ultra-violet light. The essentials of this method are a thin film of milk flowing at a definite rate at a definite distance from a source of ultra-violet light of definite intensity. Milk so produced is called "Irradiated Milk" and must contain at least 50 Steenbock or 135 U.S.P. units of vitamin D per quart.

3. By adding vitamin D concentrates to milk. This consists simply of adding to milk amounts of a vitamin D concentrate of known potency proportional to the size of the batch of milk treated. Milk so treated is called "Fortified Milk" and must contain at least 150 Steenbock or 400 U.S.P. units of vitamin D per quart.

When milk enriched with vitamin D became a possibility, the medical profession became interested in the clinical value of such milk in the treatment of infantile rickets. Even though these milks were shown to have so many rat units per quart, the question arose as to how effective were these rat units for humans, especially since it was known that more rat units of D in the form of irradiated ergosterol are needed than in the form of cod liver oil. After all, the final proof of the value of enriching milk with vitamin D lay in actual trials with the species for which benefit was intended—the human infant. Such trials have been conducted by various investigators.

Results of the first clinical trial in this country on the feeding of infants with vitamin D milk was reported by Hess, Lewis, Mac Leod, and Thomas in 1931. Nineteen infants, selected from baby clinics in New York, were fed daily for three months an average of 24 ounces of milk from cows which had been fed irradiated yeast. Three of the infants had shown X-ray evidence of rickets at the beginning and all the infants receiving this milk were free from the disease at the end of three months. The vitamin D potency of the milk fed was estimated to be approximately 160 Steenbock (432 U.S.P.) units per quart. The authors concluded from this study that yeast milk was found to prevent as well as to cure rickets.

Wyman and Butler in 1932 published results of a careful clinical study which differed from that of Hess in that the infants were hospitalized and blood calcium and phosphorus data, as well as X-ray evidence, were obtained. Four cases of definite rickets were fed 32 to 40 ounces of yeast milk daily for approximately six weeks. After two weeks of such feeding there was definite evidence of healing which progressed throughout the test. The milk used was

not assayed for vitamin D, but from the yeast feeding schedule followed, it was calculated that the milk contained 400 U. S.P. units per quart.

Later in 1932 a clinical report of a prophylactic trial with irradiated milk was made by Hess and Lewis. Of 100 out-patient cases, details on only 36 non-rachitic infants and 14 rachitic cases are given. These were all fed from 24 to 32 ounces of irradiated milk per day. Thirty-five of the 36 non-rachitic infants did not develop rickets in three months; all of the 14 rachitic cases showed definite signs of healing in four to six weeks. The milk used was reported to contain 50 Steenbock (135 U.S.P.) units of vitamin D per quart.

In the following year (1933) another paper by these same authors reported a curative trial designed to compare the relative efficiencies of yeast milk and irradiated milk. For out-patient cases the number of infants used in this study was small, four being fed 24 ounces daily of irradiated milk estimated to contain 143 U.S.P. units per quart, five being fed 24 ounces daily of yeast milk estimated to contain 306 U.S.P. units per quart, and five being fed 24 ounces daily of yeast milk estimated to contain 204 U.S.P. units per quart. Six other infants receiving only 16 ounces of irradiated milk daily did not make a favorable showing. All cases receiving 24 ounces of any of the three milks were benefited by the treatment. Because of the technique employed and the small number of cases involved no just comparison of the relative efficiencies of irradiated milk and yeast milk can be made although the authors were of the opinion that 108 U.S.P. units of vitamin D in the form of irradiated milk were equivalent to 162 units of vitamin D in the form of yeast milk. A general interpretation of these results would be that both types of vitamin D milk were beneficial in the treatment of infantile rickets when 24 ounces were fed daily.

Also in 1933 there appeared a report by Kramer and Gittleman, of a carefully controlled curative experiment in which irradiated milk and yeast milk were compared at two different levels of vitamin D intake—148 and 108 U.S.P. units daily. The number of cases used was small but all were hospitalized throughout the trial. These investigators found no significant difference in effectiveness between the two types of vitamin D milk, unit for unit. A similar conclusion was reached by Gerstenberger, Horesh, Van Horn, Krauss and Bethke and by Wyman, Eley, Bunker and Harris. The reports of both these studies have just recently appeared. In both cases the curative procedure was followed; the infants were hospitalized throughout; a preliminary observation period was adhered to before treatment began; röentgenograms, serum calcium and phosphorus, and in one study phosphatase, were used as criteria, and the milks fed were carefully controlled as to potency. Several levels of each kind of milk were fed and definite healing was obtained in all the cases studied. The lowest levels of vitamin D fed in these two trials were 74 U.S.P. units as yeast milk and 108 U.S.P. units as irradiated milk.

From the clinical evidence thus far reported in this paper it would seem that commercially produced irradiated milk and metabolized vitamin D milk are now adequately supplied with vitamin D. However, there appeared late in 1934 a paper by Drake, Tisdall, and Brown of Toronto, which strongly suggests that the age of the infant is an important factor in determining its vitamin D requirement. Infants under four months of age were not completely protected by receiving 20 to 40 ounces daily of 151 U.S.P. unit irradiated milk for five winter months; older infants were completely protected on 20 ounces of the same milk and in some instances there were cures of initial mild rickets. In the opinion of the authors: "It is desirable during the early months of life to supplement the vitamin D administered in the form of (irradiated) vitamin D milk with some other antirachitic substance."

There are but few published studies on the clinical value of milks to which vitamin D has been added directly. Wilson (1934)

reported on 33 infants fed for three to six months on 26 ounces of milk containing 400 U.S.P. units per quart. More than half the cases observed developed some degree of rickets according to X-ray findings. As contrary evidence is the work of Barnes (1934) in which 32 infants were protected for four or five winter months on a daily intake of 135 U.S.P. units of vitamin D added to milk as a cod liver oil concentrate (Vitex). Six other infants with initial rickets healed gradually and definitely.

Jeans and Stearns (1934) using calcium retention as the criterion, made a study of the utilization by infants of vitamin D from different sources. Irradiated evaporated milk, evaporated milk containing a cod liver oil concentrate (Vitex), and evaporated milk plus vitamin D given separately as cod liver oil, were compared.

The youngest infants received only 60 U.S.P. units of D daily, but by 16 weeks of age all the infants were ingesting approximately 135 U.S.P. units of D.

The results obtained in this study showed that the amount of calcium retained by infants from a given intake of milk will be determined in part by the quantity of vitamin D ingested, and that a given rat unitage of this vitamin from any one of the three sources studied is equivalent to the same rat unitage from either of the other two sources.

According to the manufacturers of other vitamin D concentrates, reports on clinical studies of the antirachitic effectiveness of milk to which their products have been added are either in the process of publication or have been submitted to the American Medical Association.

THE value of vitamin D milks for other purposes and for other age groups might also be discussed. Dental development, resistance to infection, and possible benefits to the developing embryo are some of the phenomena that have been given consideration. The data concerning these points are fragmentary and contradictory and for the present, at least, it is possible to make positive appraisal of vitamin D milks only in terms of antirachitic effectiveness. Even in this connection more information is desirable. It would be advantageous to know, for example, the minimum number of units of vitamin D in each of the vitamin D milks being produced that would surely protect or cure in all the susceptible age groups.

NOW that vitamin D milks are available, physicians, public health officials and consumers have a right to ask, "what assurance do we have that a given sample of milk contains the specified amount of vitamin D?" The control work really begins not after the milk is produced but at the source of production of the materials and apparatus used. The irradiated yeast, the irradiation equipment, and the various vitamin D concentrates must first be standardized before being sold to the trade. Unless this were done, no matter how carefully the instructions of the manufacturer were carried out some difficulty might be experienced in producing vitamin D milk of the proper potency. There is every reason to believe that this phase of the control work is being done as well as is physically possible.

The control of the product consumed is more difficult. The only way in which the amount of vitamin D in a given sample of milk can be officially determined is by conducting a bioassay with rats. This is a costly and time-consuming procedure; consequently if too strenuous demands for bioassays are made the cost would soon offset the profits of those handling a small volume and would preclude vitamin D production in some small communities entitled to its benefits. Consequently, until some cheap, rapid method for determining vitamin D content is discovered a certain amount of reliance must be placed upon those engaged in the supervision and control of this product.

In the yeast feeding method strict adherence to a yeast feeding schedule which has been shown by trial to be reliable is the first essential. After about three weeks from the time yeast feeding is begun, the producer is required to submit a sample of milk to the yeast manufacturer for bioassay. Aside from this initial assay no further assays need be made unless demanded by the health board

in whose territory the milk is being produced. However, by an elaborate system of records based on reports submitted by the feeder, close supervision of the yeast feeding program can be exercised.

In the case of irradiation both mechanical control and bioassays are used in controlling potency. The apparatus used in irradiation is equipped with devices which record the amount of radiant energy imparted to the milk and the rate of flow of the milk. When these two factors have the proper values the milk should, based upon biological assays made previously on milk produced under the same conditions, have the proper potency. It is not at all impossible that mechanical recording of this type will eventually serve as well for determining the vitamin D potency of irradiated milk as does the recording thermometer chart for controlling the heat treatment in pasteurization. In addition to this mechanical control the Wisconsin Alumni Research Foundation bioassays the milk about once a month.

In the case of direct addition, three to four assays a year are required, plus additional assays demanded by local health authorities.

Thus it is seen that the biological control demands may vary from only one assay, in the case of a yeast feeder in a community where the health officer exercises no supervision, to 12 assays a year. Such a state of affairs is not conducive to harmony and steps will probably be taken to establish uniform regulations, perhaps under state control. The federal government has thus far exercised no control.

UP to the present point everything that has been said relates to fluid milk. Mention should be made that vitamin D evaporated milk is now generally available at no increased cost. Irradiation and direct addition are the two methods thus far employed to increase the vitamin D content of evaporated milk. Because of its use in special infant feeding, its adaptability to welfare programs, and its low cost, this product affords a means of exerting some benefit on a large number, particularly of that group to which common antirachitic agents are unknown or inaccessible.

IN order to determine to what degree steps should be taken to build up a program around vitamin D milk as a public health measure, a positive answer to the following question must be obtained: "Is this a new fad which will soon wear off or is vitamin D milk here to stay?" No one can deny the need for a universally satisfactory carrier of vitamin D, and no one can deny that milk comes nearest to being such a carrier. The premises, therefore, seem sound. There is reason to believe that if properly handled, vitamin D milk will become as common as pasteurized milk; on the other hand, should too many obstacles be encountered, it is possible that this product may revert to the special milk class. Its ultimate fate will rest largely with the medical profession. This body will be guided not only by clinical evidence of the past, but upon that of the future. With more and more kinds of vitamin D milk appearing, the task of evaluating each kind and establishing standards and suitable control measures becomes more involved. It would seem that in order to work out a safe, practical vitamin D milk program with public health improvement as the ultimate object, there must be close cooperation between the medical profession, public health officials, manufacturers of the materials and equipment used, and milk producers and distributors. Such cooperation, with vision that maintains the proper perspective between permanent good and immediate gain, will undoubtedly result in the right course being taken.

Zusammenfassung

Der Vitamin D. Gehalt der Handelsmilch kann erhöht werden entweder durch Fütterung der Kühe mit bestrahlter Hefe, oder durch die Bestrahlung der Milch mit ultra-violettem Lichte, oder durch Bienmischung von Vitamin D Konzentraten. Die in der Literatur niedergelegten Versuche mit den drei verschiedenen Vitamin D. Milch produkten werden gewürdigt.

Prevention and Treatment of Parasites of Large Domestic Animals*

By WILLARD H. WRIGHT,
Washington, D. C.
Zoological Division, Bureau of Animal Industry, United States Department of Agriculture.

PREVENTION of parasitism in our domestic animals is primarily the business of the farmer and stockman, but the treatment of parasitism is the business of the practicing veterinarian. By and large, the farmer is usually indifferent to the practice of preventive methods for the control of parasites. His indifference is due partly to the non-spectacular losses occasioned by parasites, losses which frequently escape his attention, and partly to the fact that he has not been fully informed concerning the benefits to be derived from the control of parasitism. Sometimes his interest can be stimulated to the point of full cooperation as in the horse parasite control campaigns carried out in Iowa and Illinois, or in the liver fluke campaign being carried out in some of the western states; sometimes he is forced into cooperation under the compulsion of laws, as in the tick eradication campaign. In the Soviet Union parasite control is carried out on a vast scale and no doubt excellent results have been obtained from the efforts of the state to combat parasitism in flocks and herds. Under our system of government, however, it is doubted whether we are justified in trying to make the prevention or control of most animal parasites a compulsory matter at this time; rather we shall have to use the existing agencies to stimulate interest in this problem, and here the practicing veterinarian is in a strategic position to take the lead, as he has already done in many communities.

Parasites of Horses

Prevention of most parasites of the horse is a difficult matter on the average farm. The infective larvae of such parasites as the horse strongyles are extremely resistant to external conditions and can probably live for years on pastures. In experiments carried out in Montana third-stage strongyle larvae remained alive after exposure to atmospheric conditions for two years and eight months; during this period the lowest temperature recorded was —38°F. and the highest recorded was 107°F. On thoroughbred breeding farms, where the expense is warranted, good results have been obtained in horse parasite prevention by the use of strict stable sanitation, regular treatment of mares and foals, proper manure disposal, frequent rotation and light stocking of pastures, and collection of manure from pastures and paddocks. Not all of these measures can be carried out economically on the average farm. However, on many farms it is possible to apply economically certain measures which will aid in keeping down parasitic infestation to a minimum. Among these measures are light stocking of pastures, rotation of pastures or rotation of horses and cattle or sheep on the same pasture, frequent removal of manure from stables, feeding of hay and grain from racks and feed boxes, and the use of fly traps in manure pits or the storage of manure in specially constructed double-walled boxes in which the heat generated by the manure is sufficient to destroy most parasite larvae, and in which steam sterilization of manure is even more efficient.

While the prevention of strongylidosis is a difficult matter, the prevention of ascarid infestation in colts is a relatively simple procedure and one which can be practiced effectively on most farms. The application of a modified swine sanitation system will effectively protect foals from ascariasis. In this connection, the foaling barn should be of

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

sanitary construction. Before the mare is placed in the foaling stall, the stall should be cleaned and scrubbed with hot water and lye. If the mare is harboring ascarids, treatment for the removal of these worms should be instituted before the mare is in the late stage of pregnancy. Before the colt is allowed to feed, the udder of the mare should be washed with warm water and soap. The mare and foal should be kept in a clean paddock, adjoining the barn. It is best to use a paddock from which other horses have been absent for at least a year, preferably longer. When the foal is moved to a pasture, it is essential to select one which is clean and has not been used by horses for a year or longer.

Treatment of horses for the removal of parasites accomplishes a considerable amount of good, but treatment alone, without the use of some measures to prevent reinfestation or at least to decrease the rate of reinfestation, is a temporary expedient.

There is no one drug or combination of drugs which is effective for the removal of all species of gastro-intestinal parasites from the horse. Consequently, diagnosis is the first essential from the standpoint of determining the species of parasites present and indicating the type of treatment to be used. In treating horses for the removal of parasites from the stomach and small intestine, the animal should be fasted for 18 hours; for the removal of parasites from the large intestine, the period of preliminary fasting should be 36 hours. Water may be allowed during this time but it is advisable to withhold both food and water for 3 to 4 hours after the administration of anthelmintics.

Carbon disulphide in a dose of six fluid drams (24cc) for a 1,000-pound animal is the most effective drug available for the removal of bots, ascarids and certain species of stomach worms from horses. The drug need not be followed by a purgative; fats and oils are particularly contraindicated. For the treatment of stomach worm infestation, it is advisable to pass the stomach tube and employ gastric lavage with 10 quarts of a two per cent solution of sodium bicarbonate administered at body temperature. The use of this solution tends to remove much of the tenacious mucus covering the wall of the stomach and allows the carbon disulphide to come in contact with the parasites which may be partly buried in the mucosa. After 10 to 15 minutes the soda solution should be siphoned off and the carbon disulphide administered.

Oil of chenopodium in a dose of 4 to 5 fluid drams (16 to 20cc) for a 1,000-pound animal is very effective for the removal of large strongyles, small strongyles and pinworms. It is only about 25 per cent effective for the removal of ascarids. The drug should be immediately preceded or followed by one quart of raw linseed oil, or the chenopodium may be administered in the linseed oil. Oil of chenopodium is contraindicated in chronic constipation, gastro-enteritis, febrile conditions, and in weak or debilitated animals. It should not be given to pregnant mares.

Carbon tetrachloride in a dose of 6 to 12 fluid drams (25 to 50cc) is effective for the removal of ascarids and large strongyles from horses, but only about 50 per cent effective for the removal of small strongyles. Except in the case of heavy ascarid infestation in foals, the drug need not be followed by a purgative; if a purgative is used, sodium sulphate is the drug of choice. Carbon tetrachloride frequently causes central necrosis of the liver with guanidine retention and lowering of the blood calcium level. It is contraindicated in animals suffering from calcium deficiencies, and animals which have had an abrupt change of feed from 10 days to a few weeks previously. Long experience indicates that abrupt changes in feed pave the way for various unforeseen results of an unpleasant sort in connection with drugs, sera, disease and other factors. Doctor Jay of the Bureau of Animal Industry, has found evidence that carbon tetrachloride is one of the drugs which is dangerous during an indefinite period after a sudden change in feed.

Oil of turpentine is of value in removal of pinworms from horses. It should be

given in a dose of two fluid ounces (60cc) for a 1,000-pound animal and followed immediately by one quart of raw linseed oil.

Tetrachlorethylene is not effective for the removal of most species of parasites from the horse. At a dose rate of 0.15cc per kilogram (2.2 pounds) of body weight, the drug is 50 to 75 per cent effective for the removal of bots and might be employed in weak, debilitated animals where a reaction from carbon disulphide might be expected.

Parasites of Sheep

In spite of the great amount of work which has been done on the subject in the past 20 years, the problem of prevention and control of gastro-intestinal parasitism in sheep is still a complex one. Many factors enter into this problem, including degree of stocking on pastures, types of pasture, degree of pasture contamination, climatic conditions, resistance to infestation, nutrition, and medicinal treatment. Not all of these factors are easily controlled, and even the controllable factor of medicinal treatment is not entirely on a satisfactory basis.

As regards the common stomach worm, *Haemonchus contortus,* we have two methods of control, viz., the use of temporary pastures or the use of permanent pastures plus regular treatment in areas where the common stomach worm is prevalent. Experiments at the North Carolina station indicate that lambs may be carried throughout the grazing season on temporary pastures without medicinal treatment, and that the value of temporary pastures in respect to control is equivalent to the value of drenching lambs on permanent pasture at 14-day intervals. In this case, however, the balance from the standpoint of growth and development is in favor of temporary pastures as lambs on such pastures did better than lambs on permanent pastures and drenched at regular intervals. Where sheep are maintained on permanent pastures, treatment at three-week intervals in the northern states is sufficient to prevent inroads of the common stomach worm.

When it comes to controlling other gastro-intestinal parasites, such as *Ostertagia* spp., *Cooperia* spp., *Nematodirus* spp., and *Trichostrongylus* spp., we are not so well off. Evidence would seem to indicate that the eggs or larvae of these forms are even more resistant to atmospheric conditions than are the eggs or larvae of *Haemonchus contortus.* Larvae of *Ostertagia* on pastures will retain their infectivity for 8 to 10 months in sufficient numbers to cause severe disease; *Nematodirus* larvae will retain their infectivity *en masse* over winter; and embryonated *Trichostrongylus* ova are particularly resistant to drying. Thus we may have severe outbreaks of parasitic gastro-enteritis in sheep during the late fall, winter or early spring, when conditions are not favorable for the propagation of *Haemonchus contortus,* outbreaks in which *H. contortus* may not be concerned primarily.

There is increasing evidence to indicate that nutrition plays an important rôle in the susceptibility of sheep to parasitism. Thus Ross and Graham found in Australia that sheep fed nutritional supplements suffered a lower mortality rate from mixed parasitic infestations than did sheep maintained on the same pastures without such supplements. Further, Ross and Gordon noted that age resistance or acquired resistance to *Haemonchus contortus* in old sheep may be completely broken when the sheep are fed on a diet markedly deficient in proteins and minerals. Fraser and Robertson in Scotland carried out a rather carefully controlled experiment in which two groups of parasite-free lambs were maintained up to four months of age on different rations, one group receiving a more nutritious ration than the other. The lambs were then allowed to graze on naturally infected pastures for 46 days, at the end of which time they were slaughtered. The animals in the poorly-fed group were found on necropsy to harbor on an average over three times as many stomach worms (*Haemonchus contortus*) as the lambs in the well-fed group. Taylor in England found that a deficient diet lowers the resistance of sheep to mixed parasitic infestations to a marked degree. As a general measure of prevention, there-

D. W. Ashcraft, O. S. U., and Frank Breed, Lincoln, Nebr.

fore, we can urge the sheep man to maintain his flock on a high nutritional balance with the view that proper nutrition will probably influence the degree of parasitism, but probably will not in any way effect a cure and may not alleviate the condition when parasitism has reached an acute stage.

Prevention of tapeworm infestation in sheep cannot be practiced with complete satisfaction until the life history of the anoplocephaline tapeworms is determined. However, a method of control, based on treatment, has been advocated recently by Skrjabin and Schulz of the Soviet Union, in which country the plan is in active operation apparently with satisfactory results. This plan is predicated on the findings of Seddon in Australia, confirmed by Loseff in the U.S.S.R., that lambs begin to pass tapeworm eggs and segments 40 to 50 days after being placed on infected pastures. The system of control advocated by Skrjabin and Schulz provides for treatment of lambs exposed to infection when the lambs are a month to a month and a half old and within 30 to 40 days after they have been placed on infected pastures; thus before the tapeworm proglottids have reached maturity and are egg-bearing. This method not only frees the animals from tapeworm infestation before the infestation has had an opportunity to make serious inroads on the health of the animals but has the additional advantage of preventing reinfection of pastures by eliminating tapeworms before they have reached the egg-bearing stage. Furthermore, evidence would tend to indicate that tapeworm infection will die out on pastures in from 18 to 24 months after infested sheep are removed from the pastures. If this observation is correct, tapeworm infestation can probably be controlled by suitable rotation of pastures.

The above plan is based on the belief that there are effective treatments for the removal of tapeworms (*Moniezia* spp.) from sheep. Of this, we cannot be so certain. In our hands, many of the drugs recommended in the past for the removal of sheep tapeworms have failed to remove the heads, in about 50 per cent of the cases. The kamala-copper sulphate mixture recommended by Brandenberg, the copper sulphate and nicotine sulphate solution, and koussein have failed to give consistent results in critical tests on sheep infested with *Moniezia* spp. The first two treatments appear to be better than the last. The treatment recommended by Brandenberg consists of a mixture of three ounces of powdered copper sulphate to one pound of kamala. The mixture is administered in hard gelatin capsules in the following dosage: Adult sheep, 1.5 drams; 60 to 90-pound lambs, 1 dram; 40 to 60-pound lambs, 40 grains; and 30 to 40-pound lambs, 30 grains. The copper sulphate and nicotine sulphate solution is made up in the proportion of 1 ounce of 40 per cent nicotine sulphate (Black Leaf 40) to each gallon of a one per cent solution of copper sulphate. The dose of the mixture is the same as that of the one per cent copper sulphate solution mentioned below. This solution has the advantage over the kamala-copper sulphate mixture in that it is very effective against some nematode parasites and partially effective against others.

For the removal of the common stomach worm, *Haemonchus contortus,* we have available a number of treatments, among them the one per cent copper sulphate solu-

tion, the copper sulphate and nicotine sulphate solution, and tetrachlorethylene. The one per cent copper sulphate solution is administered usually in doses of 3½ ounces for adult sheep and 1½ ounces for weanling lambs. The copper sulphate and nicotine sulphate solution may be administered at the same dose rate. Tetrachlorethylene is given in a dose of 5cc in hard gelatin capsules for adult sheep and 2.5cc for lambs.

Either the copper sulphate and nicotine sulphate solution or tetrachlorethylene is quite effective for the removal of hookworms, *Bunostomum trigonocephalum*. Carbon tetrachloride at a dose rate of 1cc per 10 pounds of body weight, followed by magnesium sulphate, is very effective for the removal of hookworms but it is not so safe as is tetrachlorethylene. Sheep treated with carbon tetrachloride should be placed on a high calcium diet 10 days to two weeks before treatment and should have no change of feed for a period of 10 days to several weeks immediately preceding or following the administration of the drug.

There is no dependably effective treatment for the removal of small trichostrongylids from sheep. Such forms as *Ostertagia, Cooperia, Nematodirus* and *Trichostrongylus* spp. are usually resistant to most treatments, although tetrachlorethylene or the copper sulphate-nicotine sulphate solution will remove some of them. In severe outbreaks, repeated treatments with either of these drugs is of value. Repeated treatments with either of these drugs will remove many whipworms and nodular worms from sheep, although we do not possess effective, single-dose treatments for these parasites.

Parasites of Cattle

The measures applicable to the prevention and control of parasites of sheep apply also to parasites of cattle. Treatment for cattle parasites is on a very unsatisfactory basis at the present time and we have no dependably effective treatments for destroying worms other than the common stomach worm, *Haemonchus contortus*. Either the one per cent copper sulphate solution or the copper sulphate and nicotine sulphate solution may be used for this purpose. The dose of either solution ranges from 3½ ounces for young calves up to one quart for a full grown animal.

Parasites of Swine

Prevention of infestation with most swine parasites centers around the swine sanitation system designed for the control of *Ascaris suum*. That system of sanitation is too well known to need any discussion here. The use of this system will prevent infestations with lungworms of the genera *Metastrongylus* and *Choerostrongylus*, since these parasites are transmitted by species of earthworms prevalent around the hog lots and manure piles. Under the sanitation system where pigs are transferred at 10 days of age to clean pastures, they will have far fewer opportunities to pick up the intermediate hosts. With suitable modifications, the swine sanitation system can be adapted to the control of nodular worms also.

The treatment of ascariasis in swine with oil of chenopodium is too well known to call for comment here. Experiments in the Zoological Division indicate that the swine stomach worms, *Hyostrongylus rubidus* and *Ascarops strongylina*, may be removed effectively by the use of carbon disulphide, administered preferably by stomach tube, at a dose rate of 8cc per 100 pounds of body weight. Prior to treatment the pigs should be fasted for 36 hours, as it is essential that the stomach be absolutely empty at the time of treatment if good results are to be obtained. For other common parasites of swine, such as the thorn-headed worm, the whipworm and the nodular worm, we have no satisfactory treatment at present.

Zusammenfassung

Die hygienischen Methoden zur Verhütung des Wurmbefalles der Schweine sind auch für die Verhinderung des Wurmbefalles der Fohlen zweckdienlich. Der Wurmbefall der Schafe und Rinder ist schwer zu verhindern. Die Bekämpfungsmassregeln lassen viel zu wünschen übrig. Die Verhütung des Wurmbefalles der Schweine stützt sich auf die Anwendung hygienischer Massnahmen.

The Author

The Treatment of Dogs and Cats Infested With Internal Parasites*

By WILLARD H. WRIGHT,
Washington, D. C.
Zoological Division,
Bureau of Animal Industry,
U. S. Dept. of Agriculture.

PERHAPS no branch of therapy is on a sounder basis at the present time than is anthelmintic medication against many parasites of domestic animals. During the past two decades veterinarians have discarded largely the manifold worm mixtures of the empirical school and have adopted rational therapy involving the use of drugs demonstrated by critical experiments to be effective. Most of the basic research in anthelmintics has been carried out on dogs, and such research has provided us with very satisfactory treatments for many of the helminth parasites of these animals. However, there are still some gaps in our armamentarium against worm parasites of the dog and cat. Perhaps it will be well to discuss these points first.

Tapeworms

Tapeworms of dogs.—Treatment for tapeworms is on a fairly satisfactory basis as concerns removal of tapeworms of the genus *Taenia,* but not so satisfactory as regards the removal of tapeworms of the genus *Dipylidium.* Standard drugs such as arecoline hydrobromide, oleoresin of male fern, or kamala, named in the order of preference, will usually remove all or nearly all taenioid cestodes from dogs. However, the efficacy of these drugs against the double-pored tapeworms is variable. Probably arecoline hydrobromide is most reliable for the removal of *Dipylidium* spp.; when the drug acts at all, it usually acts to remove most of the worms but in some cases it fails entirely. In such cases, the dose should be repeated or some other remedy tried. The difficulty here is mechanical; the head must be removed and when it is buried deep in the mucosa, our drugs fail, not from any lack of potency but because they cannot reach the deeply buried head.

We prefer to withhold food for 24 hours before treatment for tapeworms. A purgative is not needed with such purgative drugs as kamala or arecoline hydrobromide, but in the case of male fern it is advisable to precede or follow the drug immediately with an adequate dose of castor oil. I know that in this recommendation I am going against the advice of therapists in human medicine but Hall has demonstrated convincingly that the use of large doses of castor oil is of advantage following male fern and that the oil does not increase absorption of the drug in the dog. Preliminary purgation with salines 24 hours prior to the administration of arecoline hydrobromide may enhance the action of the drug by removing mucus from the region around the tapeworm head. If prompt purgative action does not follow the administration of arecoline, high enemas are of value in hastening the action of the drug. Constipated animals should be given an enema an hour or so before anthelmintic treatment.

DOSAGE: Arecoline hydrobromide, $\frac{1}{16}$ to ½ grain.

Oleoresin of male fern, 2 to 4 grams (½ to 1 dram).

Kamala, 2 to 6 grams (0.5 to 1.5 drams).

These drugs are contraindicated in very young or very old animals, in those in a weakened condition, and in those suffering from gastro-enteritis.

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

Tapeworms of cats.—Treatments for the removal of tapeworms from cats usually exhibit the same variable efficacy as in dogs. Oleoresin of male fern is too toxic a drug for use in cats. Arecoline hydrobromide is more toxic for cats than it is for dogs, and the drug should be used with extreme care in cats. The dosage for adult cats varies between 1/24 and 1/16 grain. The latter dose should not be exceeded. We have killed 8-pound cats with a 1/8-grain dose of arecoline.

Kamala in a dose of 1 gram (15 grains) for adult cats is about 50 per cent effective for the removal of *Taenia* spp. but is less effective for the removal of *Dipylidium* spp. From the standpoint of efficacy, arecoline hydrobromide has preference, but kamala is less toxic.

Whipworms

Treatment for whipworm infestation in the dog is far from being on a satisfactory basis. The problem of removing whipworms is largely a mechanical one. Almost any anthelmintic which penetrates the cecum in any quantity will remove the whipworms with which it comes in contact, but few anthelmintics given orally regularly enter the cecum. The problem resolves itself, therefore, into the premise of giving small repeated doses of an anthelmintic such as santonin, or a relatively large single dose of a bulky anthelmintic such as leche de higueron, with the view that either method will result in some of the anthelmintic reaching the site of the worms. Unfortunately, leche de higueron, the sap of certain Central and South American fig trees, such as *Ficus laurifolia,* is not obtainable in this country, nor can the preserved sap be imported at a price which would warrant its use in veterinary medicine; consequently we are forced to fall back on santonin given in doses of one-quarter to one grain with an equal amount of calomel, daily, for a week to 10 days.

The pathogenicity of the dog whipworm has been questioned by some parasitologists. I am convinced, however, that the whipworm, particularly in heavy infestations, may be responsible for clinical or subclinical conditions such as chronic digestive disturbances, intermittent or persistent diarrhea, and chronic cecitis. In cases of this sort which remain refractory to the santonin and calomel treatment, I would not hesitate to recommend cecectomy as a final resort. Such cases usually respond remarkably well to surgical interference and it has been our experience that not only do the symptoms disappear but the general condition of the dog improves rather strikingly.

There is another method of therapy for whipworm infestation which may be developed to the point of practical application, namely, the intracecal injection of drugs by way of the rectum. In this connection, Underwood, Wright and Bozicevich failed to remove whipworms in most cases by the injection of anthelmintics through a rubber catheter passed per rectum to the vicinity of the cecal orifice. It is possible that repeated injections of anthelmintics in this way may be of some value, or it is possible that the technic of injection could be so improved that penetration of the anthelmintic into the cecum could be obtained more frequently. This appears to be a promising method of therapy for the removal of whipworms provided a suitable technic can be worked out.

Ascarids

For the removal of *Toxocara canis* and *Toxascaris leonina* from the dog, no drug is more effective than is oil of chenopodium at a dose rate of 0.1cc per kilogram (2.2 pounds) of body weight or 1cc for a 22-pound dog. Chenopodium should always be preceded or followed by a purgative dose of castor oil. Many of the bad results reported from the use of this drug have been due undoubtedly to use of an insufficient dose of purgative.

Oil of chenopodium is contraindicated in very young or very old animals, and in those suffering from distemper, gastro-enteritis or chronic constipation.

Chenopodium is twice as toxic for cats as it is for dogs and the drug should be used with extreme caution in cats. The dose should not exceed 0.05cc per kilogram of

body weight or 0.25cc for an 11-pound cat. As with dogs, the drug should be preceded or followed immediately by a purgative dose of castor oil.

Tetrachlorethylene is the remedy of choice for the removal of ascarids from cats. The drug is well tolerated by these animals and is very effective if followed in four to five hours by an adequate dose of castor oil. Fats or oils should not be given immediately preceding or following tetrachlorethylene, as they increase absorption of the drug, and absorption may be followed by systemic reactions. The dose of tetrachlorethylene for dogs or cats is 0.2cc per kilogram of body weight or 2cc for a 22-pound animal. In the case of the dog, it is not necessary to follow tetrachlorethylene with purgatives except in young animals heavily infested with ascarids. Like carbon tetrachloride, tetrachlorethylene tends to cause clumping of ascarids in the small intestine. In heavy infestations, particularly in young animals, such clumping may result in an obstruction of the intestinal tract followed by enteritis and necrosis of the wall of the bowel. Tetrachlorethylene may be followed immediately by a suitable dose of sodium sulphate or in five hours by an adequate dose of castor oil.

Hexylresorcinol is another drug which has been found effective for the removal of dog ascarids. Lamson, Brown and Ward recommended a dose of 0.6 to 1.0 gram (9 to 15 grains). Hexylresorcinol combines with the protein of the food and for this reason it is necessary to fast animals 36 hours prior to treatment with the drug. The drug also reacts with gelatin and cannot be readily administered in gelatin capsules. When administered in pill form, care should be taken that pills are not chewed by the animal for the reason that the drug is decidedly irritating to the mucous membrane of the mouth, and annoying burns may result from chewing the pills. Hexylresorcinol is contraindicated in gastro-enteritis because of its irritating action on the mucous membranes. The drug appears to be somewhat more toxic for cats than it is for dogs, and its use for the treatment of ascariasis in cats is not recommended.

Hookworms

At the present writing, nothing better than tetrachlorethylene is known for the treatment of hookworm disease in dogs or cats. This drug appears to be eminently satisfactory both from the standpoint of efficacy and safety. The dose rate is 0.2cc per kilogram of body weight or 2cc for a 22-pound animal. Except in cases with concomitant heavy ascarid infestations, the drug need not be followed by a purgative. As in the treatment of ascariasis, fats and oils should be withheld from the diet for a period of several days prior to the administration of tetraclorethylene.

There is one phase of treatment for hookworm disease which is noted only infrequently. Clinical improvement following the removal of large numbers of hookworms from man or dog is slow unless supplementary treatment is employed to stimulate regeneration of erythrocytes and hemoglobin and bring the blood picture rapidly back to normal. In such cases, the improvement in general physical condition coincides with blood regeneration. Wells has shown that the dog hookworm, *Ancylostoma caninum,* is constantly sucking blood during the period of its attachment to the mucosa of the small intestine. He has calculated that a single worm may withdraw blood from the host at the rate of 0.8cc every 24 hours. In this connection, Foster and Landsberg have shown that the anemia of hookworm disease is primarily of purely hemorrhagic origin, although in prolonged hookworm disease due to heavy infestations, it appears possible that the hemopoietic centers may be impaired secondarily. The fact that the anemia is directly due to the loss of blood and not to the primary action of toxins on the blood-forming organs, renders the anemia amenable to treatment with iron-copper therapy. This is a point well worth keeping in mind and it would appear profitable to carry out such treatment in severe types of canine ancylostomiasis. Foster and Landsberg obtained a satisfactory reticulocyte response

and hemoglobin increase in dogs following the administration daily of 2.2 grams of a 100:1 mixture of iron citrate and copper sulphate in double gelatin capsules.

Heart Worms

The treatment of infestations with the dog heart worm, *Dirofilaria immitis*, is mentioned for the reason that some of you may encounter cases in dogs brought up from the South. Futhermore, there appears to be definite evidence that this parasite is spreading northward; it seems to have invaded the states of New Jersey, Pennsylvania and New York, and is probably becoming established there. There is a possibility that it may become established in Ohio, as many of the mosquito vectors are distributed throughout the state. Furthermore, if it can be demonstrated that fleas, lice and certain species of ticks can actually transmit the parasite, absence of mosquito vectors will form no barrier to its spread.

The difficulties in the way of developing a treatment for this condition are so great that it is doubted whether an ideal treatment will ever be found. In the light of our present knowledge, we are faced with the difficulties of killing adult worms at a rate which is not in excess of the capacity of the body of the host to care for the foreign protein of dead worms, and in finding a drug which will be destructive to nematode tissue and not destructive to the tissues of the host. None of the drugs used at present for the treatment of this condition fulfil the latter specification. Furthermore, any drug which is used for the treatment of heartworm disease in the dog should be such that it can be used intramuscularly on account of the difficulty of making intravenous injections in small dogs.

It is believed that Fouadin (sodium antimony pyrocatechin disulphonate of sodium) is the most satisfactory drug available at the present time for the treatment of this condition. A suitable course of treatment with this drug results usually in the permanent disappearance of microfilariae from the circulation, in the sterilization of female worms, and in the eventual destruction of some or all of the adult worms in the heart and pulmonary artery. Fouadin* can be used either intramuscularly or intravenously. The action of the drug on adult worms is cumulative and is exerted over a relatively long period of time. The destruction of a considerable number of adult worms at any one time may result in embolic pneumonia or in an acute toxemia with consequent danger to the life of the patient. Consequently heavily infested animals should be treated with caution, and in such animals treatment should not be administered rapidly or in large doses or at too close intervals.

The administration of repeated doses of Fouadin may result in an acute central necrosis of the liver and in an acute toxic nephrosis. The drug is therefore contraindicated for use in animals suffering from acute or chronic affections of the liver or kidneys; neither should the drug be administered to animals suffering from organic heart disease. Experience in treating heartworm cases is needed to enable the practitioner to obtain best results with minimum hazard to the patient.

Zusammenfassung

Die für Hunde und Katzen geeigneten Wurmmittel werden kritisch besprochen. Die gebräuchlichen Arzneimittel sind unzuverlässig in der Abtreibung der Dipylidium Arten. Das gleiche gilt auch für die Abtreibung der Peitschenwürmer. Die zur Abtreibung der Askariden geeigneten Mittel werden besprochen. Das Abtreiben der Hakenwürmer soll durch blutbildende Mittel ergänzt werden. Fuadin ist erfolgreich in der Behandlung gegen Blutfilarien.

*For dose rates of Fouadin for intramuscular and intravenous injection see the paper entitled "Fouadin in the Treatment of Infestations with the Dog Heartworm, *Dirofilaria immitis*," *Veterinary Medicine*, 29:6, June, 1934, pp. 234-246.

The Dairymen's Problems in Producing and Handling Dairy Products*

By L. L. RUMMELL,
Columbus, Ohio
Field Editor, The Ohio Farmer.

DAIRYMEN of America, since the World War, had been in a more favorable position economically than most classes of farmers, until the last few years. They had the advantages of high-priced dairy products and cheap feeds, but during the last four or five years this condition has been reversed. So stimulating were these high prices for dairy products from 1920 to 1930, that each year there was an increase of about three per cent in the number of dairy cows, and by 1934 we had around 26 million dairy cows. This is not too many for domestic demands, if the people had full purchasing power; but with the present relief load and low purchasing power of consumers, this results in a surplus of dairy products. It is said though that for full health requirements we might well be consuming the product of at least 35 million cows.

Another factor right now in the economic position of the dairy farmer is the feed situation. The production per cow for the United States is the lowest on record. Ohio was fortunate in the drouth year of 1934, although even here our production per cow is about ten per cent below what it was five years ago. The outlook for 1935 in Ohio, with respect to the feed situation, briefly is: Poor hay prospect because of failures of seedings; more acreage to corn and small grains; pastures below normal because of overgrazing last year; and need, therefore, for emergency pastures, like sudan grass, and emergency hays like soybeans.

Dairy prices in the last year have improved about 20 per cent for milk and 50 per cent for butterfat, but feed prices have been advancing even faster; so that the Ohio dairymen today have no greater net return than a year ago. They are not included in the AAA and therefore get no benefit payments for reducing production. Furthermore, most of the dairy section of Ohio does not benefit from the wheat, tobacco or corn-hog programs.

More Attention to Quality Needed

When we consider ways to improve the dairy industry, I wish to mention first the need for improvement in the quality of our dairy products. Consumption can be increased. If the public were assured of higher quality, that is, a better taste, finer appearance, safeguards to health, it will drink more milk and eat more butter and cheese.

During the past year the federal authorities have been checking on cream in Ohio markets and have dumped hundreds of cans as unfit for food. The creamery industry of this state is aware of this situation, and under a state committee they have done an excellent piece of work to get their own house in order and to educate their patrons to take better care of their cream. Farmers need to keep this cream in a more cleanly condition; keep utensils sanitary and sweet; cool the cream; store it in a clean, cool place, and deliver it frequently, especially in the summertime.

The health authorities of Pennsylvania and some of the eastern states exclude cream from Ohio on the ground that it is unfit for food and unsafe to health. Our dairymen must meet quite rigid requirements in farm inspection if they are to get into these eastern markets, and our state set-up in milk inspection must be coordinated between the health department and the department of agriculture if certificates are to be accepted by other state health authorities.

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

Another mark of poor quality in our dairy products is the consumption of dairy substitutes. I know that people turn from butter to oleomargarine when the price goes too high, and today with butter around 40c and oleomargarine less than half that figure, the poorer families, and even those who can afford butter, will take the substitute as an economy measure. However, rather than try to exclude substitutes by legislation, let us strive to make our dairy products of better taste and appearance. Some of the poor, country butter I get occasionally is a good argument for oleomargarine. This year the oleomargarine consumption in this state is double what it was a year ago; yet notwithstanding this competition, the federal inspectors found hundreds of cans of rotten cream unfit for manufacture into any food product.

Control of Bovine Diseases

It is in the control of diseases of cattle that the veterinarian has his main concern with the dairyman. Ohio is spending more than $1,000,000 of federal funds this year as indemnity for reactors to the Bang's disease test. Ohio is one of the leading states in this new federal project, along with Wisconsin and Minnesota. A. J. DeFosset, federal inspector in charge for Ohio, reports 1,500 claims already, 7,689 reactors and an average indemnity of $30.30 in addition to salvage of $16.33. Ohio, for several years, has been promulgating a constructive program for the control of this disease, and with the limited funds available, has a good record in the establishment of accredited herds. But we need more funds from the state treasury for this work, and every dairy organization and the veterinary association should use their influence with the legislature to see that more funds are made available for this work. It is definitely established that there is a direct relationship between Bang's disease and undulant fever, and the public therefore is justified in making appropriations for control of this disease of cattle that can be transmitted to man. The state department of health has records of 875 cases of undulant fever; Doctor Simpson alone has had more than 150 cases at Dayton.

We should be looking forward also to control of mastitis in the city milk supply. Columbus is an outstanding example in this state of eradication of mastitis from dairy herds supplying its milk. We have $25,000 federal aid to start work in Ohio this year, but it is so insignificant, it can be used only in an educational way to acquaint dairymen with the disease and its practical control.

The third disease of major importance to our dairy industry is tuberculosis. Ohio has been on the modified accredited list for several years. Our only concern now is to remain there. The state veterinarian says that the expenditure of about $50,000 a year will accomplish this.

One measure before the Ohio General Assembly that merits the support of every veterinarian in Ohio, is House Bill 380 that provides for inspection and disinfection of public stockyards and premises used for community auction sales. We have about 170 of these places, unregulated and veritable centers of contamination for such diseases as Bang's disease, sheep scabies and hog cholera. The bill provides for licensing them without charge and then requiring that an approved veterinarian inspect livestock sold at such yards or sales if they are to go back to farms.

Farm Inspection and Milk Regulations

Veterinarians have had a most important part in milk regulations and farm inspection to safeguard city milk supplies. Under the Ohio Milk Marketing Commission, funds are available to local health authorities for such inspection service, and Ohio dairymen have advanced more in this line in the last two years than in any similar period. We need rigid inspection of these dairy plants, but at the same time this must be practicable and sensible, and the veterinarian is in position to provide that sort of service.

Attempts have been made for several years to make uniform milk regulations throughout the state, but the state department of agriculture is still using the same old dusty regulations it had nearly a quarter

of a century ago. We have advanced too far in city milk inspection to be using prewar standards.

Besides there ought to be some degree of uniformity in these standards. Today, Cincinnati excludes all raw milk, Toledo allows only certified milk in raw state, and others allow Grade A milk only, with most towns having no high standards whatever on raw milk. Acceptable raw milk in one city may mean 20,000 bacteria per cc, 50,000 in another, and 500,000 in another. Pasteurized milk means 20,000 bacteria per cc in Akron, 50,000 in Columbus and 100,000 in Cleveland, and 500,000 in one municipality. Temperatures to which milk must be cooled vary from 45 to 65 degrees. Few cities require modern milk houses. Some cities are still following those antiquated state department of agriculture regulations and score cards. All cities, I think, now require the tuberculin test, but few require the Bang test, although some, like Columbus, Akron and Canton, write this in their regulations, only for raw milk.

Why should not milk regulations mean somewhat near the same thing in Columbus as in Sidney, in Akron as in Marietta, or any of the other cities? The state department of agriculture, since it is charged with milk plant and farm inspection, should assume the leadership in this project to modernize and unify milk regulations.

These are some of the problems of the dairyman in Ohio today, and how, in my judgment, the veterinarian can fit into that picture. He should be more than just a doctor in case of disease in the herd; he should be a student of feeding and breeding; he should know sensible, sanitary dairy barn construction and the principles of clean milk production; he can be the best agency in the state for farm inspection to safeguard a city milk supply, and he can improve the economic position of our dairy herds through cooperation in the state and federal programs for control of the major diseases. The dairyman of Ohio recognizes the value of his veterinarian and the part he plays in improvement of the dairy industry.

Do You Remember?

1. Question. What are the fundamental differences between animals and plants?

Answer. Although there are many exceptions, the chief, fundamental differences between animals and plants are: Animals generally have an invariable body form; organs are internal; some have a nervous system, so respond to stimuli quickly; the adults are motile; chlorophyll is absent; they require organic food, and their waste products are water, carbon dioxide, feces and urea. Plants have a variable body form; new organs are added externally; they have no nervous system, so respond to stimuli slowly; the adults are not motile; chlorophyll is present; they convert carbon dioxide and water into organic food by photosynthesis; and they eliminate carbon dioxide, water and oxygen as waste.

2. Q. What is chemotropism?

A. Chemotropism is the ability of one or more cells to react to a chemical stimulus.

3. Q. Differentiate between sexual and asexual reproduction.

A. Asexual reproduction is that form of propagation by which two or more individuals are formed by the complete fragmentation of one individual, each fragment becoming a new individual. Sexual reproduction is that form of propagation by which one or more individuals are formed as a result of a union between two others.

4. Q. The Rhizopoda, Mastigophora, Infusoria and Sporazoa are all classes of what phylum?

A. Because of the character of their locomotor organs when present, these have all been classified under protozoa.

5. Q. Define symbiosis; commensalism, and parasitism.

A. Symbiosis is a close association between two or more organisms in which both or all are benefited. Commensalism is an association between two or more organisms, in which one is not benefited while the others are unharmed. Parasitism is an association, in which one organism harms another by living either in or upon it.

Columbus, Ohio. Wesley O. Keefer.

Treatment of Gastro-Enteritis in Dogs*

By A. R. THEOBALD,
Cincinnati, Ohio

The Author

GASTRO-ENTERITIS, as we see it in practice, is usually an acute and violent irritation of the mucous membranes of the stomach and intestinal tract, characterized by more or less vomiting, intense thirst, diarrhea, dysentery, anorexia, dehydration, weakness and prostration.

We may see it as a flare-up of catarrhal enteritis, when the intestinal tract can tolerate no longer the toxemia and destruction of its protective cells, the columnar epithelium. We see it frequently associated with nephritis from the resulting uremia. Often times it is associated with terminal metritis and pyometra, foreign bodies, canine distemper and meat and metallic poisonings. It may be associated with liver diseases. Now and then we encounter Stuttgart's disease or canine typhus in which we see a very violent gastro-enteritis.

The treatment I give is applicable to all cases in which we see acute gastro-enteritis; but do not include treatment for all the accompanying conditions, or for all the causes of gastro-enteric symptoms. The treatment of the complications also I consider most important. The alarming and threatening condition in all these cases is dehydration, which is brought on by the excessive loss of water through vomiting, diarrhea and dysentery. A loss of water in the body cells seriously handicaps an animal's chances of recovery. I think too few of us realize the value, in canine practice, of replenishing lost fluids.

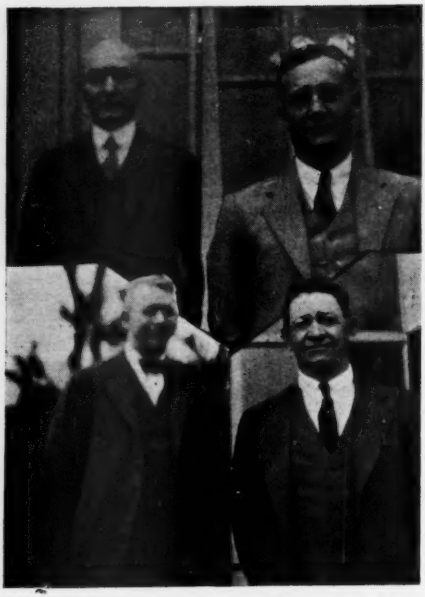
During the first 24 to 48 hours following the onset, when vomiting is pronounced, rest the stomach so far as food and water are concerned. This is the period when fluids count most. Give normal saline solution with five per cent dextrose, at body temperature, subcutaneously or intravenously. This takes care of the inadequacy of water intake and furnishes food to the impoverished cells. Subcutaneous infusion is more practical than intravenous in most cases and is easily accomplished. The advantages are that you save time in giving fluids and are assured of slow absorption. The disadvantages are abscesses and sloughs, but if ordinary care is exercised, and the subjects selected are not too badly dehydrated, there isn't much danger of this sequel.

The best sites for subcutaneous infusion (hypodermoclysis) are in the region of the thighs and armpits. It is well to distribute the saline and dextrose so as to put not more than 50 to 75cc in one area. For intravenous administration, I prefer the anterior radial vein in the forearm, as it permits the dog to take the injection sitting up and thus requires little restraint.

The use of a Shikles' intravenous outfit is a very practical and quick way to give subcutaneous infusions, but for intravenous infusions, it pushes the fluid in too fast. Gravity containers, with a dripmeter which will not allow more than 4cc per minute, should be used if the intravenous method is to be employed.

As to the amount of fluid, give 100 to 300cc, depending on the size of the dog and on its condition, three or four times a day. One thousand to 2000cc at one time once a day, as some use it, is not rational treatment. Too large an amount at one time may overwork damaged kidneys, overtax the heart

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.



Above: J. N. Shoemaker and R. E. Rebrassier, O. S. U. Below: J. D. Ray, Omaha, and C. H. York, Indianapolis.

and cause abscesses and sloughs from non-absorption. Fluids should be continued as long as dehydration threatens. In some cases when dehydration isn't a factor, fluids seem to be of value in controlling vomition.

Because these dogs have lost a lot of body heat, as can easily be determined by cold extremities and sub-normal temperatures, it becomes important to give some attention to comfort. Keep them warm by all means; if necessary, apply heat in some form.

In regard to intestinal or internal treatment, we should keep in mind always that there is a destructive process going on in the intestinal tract. The columnar epithelium of the villi are damaged and many villi have lost their columnar cells, which are protective. Drastic treatments should be avoided. Enemas of warm soda bicarbonate solution, two to five per cent, are helpful and may be given twice a day without danger of aggravating the irritation. Atropine sulphate is a valuable drug in these cases. It quiets intestinal movement and relieves spastic conditions; its sedative effect is usually enough, though sometimes other sedatives are necessary. We give atropine sulphate hypodermically, 1/300 to 1/150 grain, or in the form of a tablet combined with calcium and magnesium carbonate. This is repeated as conditions indicate. Bland oils are soothing. Mineral oil, emulsified with psyllium seed jelly, is very beneficial in the early stages of gastro-enteritis and will be retained by dogs.

The usual intestinal antiseptics have not, in my opinion, much value. The liquid forms of bismuth preparations are preferred to tablet forms. There is a preparation known as "Karicin," made by Merrell Chemical Company of Cincinnati, that has found favor with us. It consists of a very heavy mineral oil, kaolin and soricin. Kaolin and soricin are two very efficient detoxifying agents. This product has been of decided value in all cases of intestinal toxemias we have treated. We give "Karicin" in doses of one-half to one teaspoonsful two or three times a day and continue for a week or so after the acute symptoms have abated.

Various tonics may be included in the course of treatment, but they serve best during the convalescence. Often times following an attack of gastro-enteritis, a laxative condition continues. This may be due in part to an inhibition of the digestive juices. Carminatives, and digestives containing proteolytic and starch digesting enzymes, give good results when enfeebled digestion is present. Diluted hydrochloric acid and pepsin at times are indicated.

Liquid food in small doses should be the first food given any dog that has had a violent upset such as is seen in gastro-enteritis. I prefer to begin with beef tea, buttermilk and acidophilous milk. It is best to wait a day or two before giving solid foods and then only in small amounts to be increased gradually.

Zusammenfassung

Die subkutane Verabreichung von Wasser und die Anwendung von Wärmebehandlung sind wichtige Hilfsmittel für die Klinik der Magendarmkrankheiten.

Illegitimate Use of Drugs on Race Horses

By T. C. FITZGERALD,
Columbus, Ohio,
Veterinary Anatomy,
Ohio State University.

The Author

TWO years ago the "doping" of race horses was a common practice at American race tracks. It had reached a point where racing became more of a competition between prescriptions than between horses. Finally, an aroused body of sportsmen, and lovers of horse flesh, began crying for reform.

To Joseph E. Widener, millionaire sportsman and owner of the famous Hialeah Belmont race tracks, goes considerable credit for the war against the use of narcotics on race horses. It was largely through his insistence that the Florida State Racing Commission inaugurated the anti-dope campaign.

Charles E. Morgan was appointed chief chemist for the Florida Commission, and J. G. Catlett, chief veterinarian. They immediately gave the problem their full time and the results have been lauded by race track men everywhere.

Through the efforts of these two men Florida became the pioneer in the fight against doping. First they studied the records of French racing officials, who have been fighting this evil since 1912. When all the available expert knowledge had been obtained, Doctors Morgan and Catlett began experiments with all the drugs used to stimulate horses.

In the meantime, Mr. Widener was so impressed with the progress of the research that he prevailed upon the Florida Racing Commission to send the doctors to France to observe the French methods of detecting drugged animals. The report of the visit by Doctor Catlett states that the French methods are much the same as those developed in this country, except that he believes Doctor Morgan improved the test by his experiments.

The use of the saliva test dates back to June 18, 1913, at which time the French Racing Commission launched a series of experiments to test the accuracy and dependability of a chemical analysis in detecting stimulants in the saliva of race horses. It was proved beyond doubt, at that time, that the saliva test is accurate. It is still used in France.

Progress of the Test in the United States

Mr. H. J. Anslinger, Commissioner of the Bureau of Narcotics of the Treasury Department, with whom state commissions cooperate in carrying out the program, stated at the recent annual meeting of the National Association of State Racing Commissions, that the stimulation of horses in races has diminished beyond all expectation.

Commissioner Anslinger said that in 1933 his representatives had gone to the tracks, as investigators, but last year they went as observers, and he was highly gratified that all they could report as being given to the horses was oats.

However, the Commissioner had no praise for some state Racing Commissions, who had followed the direction of least resistance, and stated that at the moment the Treasury Department was considering legislation against states not cooperating with the Narcotic Division.

The saliva test requires further experimentation to produce an ideal test. There is a necessity also for uniformity and expedition of tests. The test is criticized mainly because of the method of selecting animals. The winners of two races are picked by lot

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

for testing. Additional selections may be picked if deemed necessary.

Personally, I believe that the veterinarian should be allowed to make selections of suspected animals with the sanction of the stewards, and that selections by lot should be done away with. However, the system has worked. About 60 charges of stimulation have been made against owners and trainers. That there has been no libel suit is, I think, significant. It indicates that the racing commissions have not gone off half-cocked. Where doubtful cases have arisen they have given the owners and trainers the benefit of every doubt.

Syringe Method of Taking Saliva Sample

Material.—One surgical pan, 14 inches long, 10 inches wide and eight inches deep. Three irrigating syringes, constructed of an ordinary rubber bulb connected to a horse canula, six inches long, ¼-inch bore. The canula should be of nickel or chromium plated brass. Over the canula a piece of rubber tubing ⅝-inch bore and $\frac{3}{32}$-inch wall should be slipped and fastened to the bulb with a piece of adhesive tape one inch wide. This syringe is easily taken apart and cleaned before use for a second sample. Gauze swabs two inches wide by eight inches long, and of 18 to 20 thicknesses are used.

One 250cc graduate.

Procedure.—Everything being in readiness, the horse is brought to the saliva station. The pan, having been thoroughly cleaned, dried and rinsed with distilled water, is covered with a piece of clean gauze. 250cc of distilled water in a bottle is kept at hand. Two sterile gauze swabs and a pair of sterile canvas gloves are kept in a paper sack ready for use. 150cc of grain alcohol is at hand.

The owner or trainer is notified before the judges stand at the time of dismounting, that his horse is to be tested. The veterinarian then stays with the horse *en route* to the saliva station. If a tongue strap has been used on the horse, it should be obtained and sent in with the sample. If the tongue strap is leather, it can be returned after washing it in the distilled water for the sample.

No one is admitted to the saliva station but the owner, trainer or horse attendant. The 250cc of distilled water is emptied into the pan. The gloves and gauze swabs are put in the water, then wrung out as dry as possible. The gloves are put on and one of the gauze swabs is held in the left hand and the syringe is held in the right hand. The pan is held under the horse's mouth by the owner or trainer at the right of the horse's head. The attendant stands at the horse's left and the veterinarian works directly in front of the animal. The swab in the left hand is inserted back between the molar teeth hanging on to one end. It may help if two fingers of the left hand grasp the ring of the bit. The syringe is filled with the distilled water and inserted well back both inside and outside the dental arcade for irrigation. This porcedure is continued until chewing on the gauze has stimulated the flow of saliva. This fact can be noticed by the appearance of a great quantity of foam and heavy viscous liquid flowing from the mouth. The horse should be made to chew for at least five minutes while the irrigating is being continued.

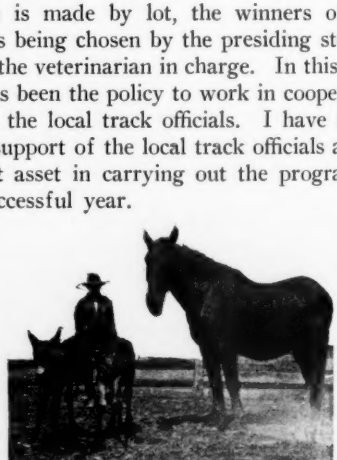
The second gauze is then taken from the pan, wrung out well and the entire mouth, including the tongue, wiped, and the gauze dropped in the pan. The groove in the top of the tongue should be wiped last.

The gloves are removed. The syringe and hands are rinsed in the alcohol as it is poured into the pan. Then the entire contents of the pan: gloves, gauze, water, alcohol and saliva, are put into a jar. The jar is labeled and sealed. The owner or trainer is then asked to sign the label; the horse is dismissed and the jar packed for shipment. The material is then made ready, as before, for the next sample.

ALL samples and materials are kept under lock while the veterinarian is away from the saliva station. The veterinarian should station himself at the paddock between races and near the judges stand during the race and be on the lookout for symptoms of doping.

Around 600 tests were run on suspected animals last racing season, at the various Ohio tracks. Only six positive samples were found. It is the policy to run at least two samples each day, whether or not anything suspicious shows up.

As before stated the selection of the animals is made by lot, the winners of two races being chosen by the presiding steward and the veterinarian in charge. In this state, it has been the policy to work in cooperation with the local track officials. I have found the support of the local track officials a very great asset in carrying out the program of a successful year.



Horse and Mule Twins

Diagnostic Methods in Small Animal Practice*

By E. F. SCHROEDER,
Boston, Massachusetts,
Angell Animal Hospital.

The Author

SMALL animal practice includes not only the dog and cat, but also other species. In considering the dog alone we encounter innumerable breeds and their characteristics. It is evident, therefore, that in order to distinguish between the normal and abnormal animal a fair general knowledge of the various breeds, their characteristics, temperaments, and care should be a part of our mental background. The animal presented for treatment may be a snappy Peke, a docile Great Dane, or a vicious Chow. It really should not matter to us what type of pet is presented. Whether it be a valuable blue ribbon winner or a lowly mut, to the owner, the animal is the only worthwhile pet in existence. He expects us to tell him what is wrong and what to do.

As intelligent treatment depends on proper diagnosis, it should be emphasized that the time spent in making a careful examination will eliminate those embarrassing moments so likely to occur as a result of the spectacular and careless "snap" diagnosis. Once the diagnosis is made, the treatment ordinarily is not difficult; all subsequent handling depends upon it.

SINCE there are no two animals exactly alike in their temperaments, it requires good judgment in making the proper approach for an examination. One should distinguish between the docile and the aggressive, and between the calm and frightened animal. To gain the animal's confidence, it should be handled without causing fright or excitement. This can be done in most instances if a proper approach is made (excepting in the case of the downright vicious or hysterical individual). There are two extremes in approach, both definitely harmful and wrong. The first: a hesitant and overly cautious approach, indicating fear; and secondly: an abrupt and aggressive or belligerent approach. In the case of apparent fear, the owner immediately loses confidence in your ability, and the animal at once becomes definitely defiant if it is an aggressive individual. By adopting the aggressive approach, the owner may tell his friends that you are brutal, and a timid animal will be frightened. In either case it makes a poor beginning, and a proper diagnosis cannot be made unless the animal is examined under more agreeable conditions. It is not inferred that an experienced observer may not make a diagnosis without laying hands on the animal. Innumerable cases are presented where the experienced clinician will recognize at a glance just what is wrong, and in most instances further examination is made only to exclude possible complications and to arrive at a more definite prognosis. A hasty approach to a strange pet is often disastrous, especially if the owner, also, is a stranger.

IN small animal practice we naturally meet as many different types of pet owners as there are types of pets, and in many instances the handling of the pet is much easier than pleasing its master. It is seldom that you are informed in advance that a dog is inclined to be snappy, and to ask if the dog is vicious or snappy often antagonizes the owner or gives him the impression that you are afraid. In those instances where the dog shows a tendency to aggressiveness, it is best to try to appear cool and indifferent. Engage in conversation, ask questions, and have the owner place the animal on the

*Presented at the Ninth Veterinary Conference, College of Veterinary Medicine, Ohio State University, Columbus, March 20-22, 1935.

Satisfying the owner is often more difficult than treating the patient.

examination table. For the downright vicious and hysterical animal, it is best to resort to morphine or nembutal, using dosage to effect.

The object of the examination is to determine symptoms. A diagnosis consists in the determination of:

1. The symptoms of the disease.
2. The diseased organ.
3. The character of the disease and its name.

BY conducting an examination according to a plan as outlined in White and Fischer's translation of "Malkmus' Outline of Clinical Diagnostics," one gradually learns to appreciate or recognize the various symptoms and abnormalities characteristic for the various diseases. In this way one acquires mental pictures of the abnormal as compared to the normal, unconsciously accumulating a storehouse of mental or visual cases for future reference and comparison.

History of the Case

Although many cases are presented where symptoms are so definitely characteristic that there is no need for a history, to aid in arriving at a diagnosis, it is just as well to lend an ear to voluntary information that is at times boresome perhaps, but probably valuable. It is possible to overlook or miss symptoms. In the great majority of instances, obtaining a history of the case is perhaps the most important means—next to a careful examination—of determining symptoms, in order to arrive at a correct diagnosis.

By being tactful in obtaining a detailed history, it is often possible to arrive at a reasonable conclusion and also have an opportunity to make a preliminary observation of the animal. In many instances the time consumed in obtaining the history will also afford an opportunity to observe and determine the animal's disposition, and to plan the necessary procedure in further examination. By observing patience in obtaining the history of a case, many unnecessary and often dangerous risks in handling may be avoided. Also by combining the information gained in obtaining the history with a careful observation of the animal during the questioning of the owner or attendant, a diagnosis is often possible without further examination. This would include such diseases as rabies, hysteria (perhaps only a symptom) and distemper. In the possibility of rabies, it should be remembered that it is the *atypical* case which may be overlooked. There is a variation in symptoms and the true to type case may be masked, in the animal affected with advanced distemper. In the early stage, the nervous form of distemper may be mistaken for rabies. Likewise, cases of fright fits often simulate both distemper and rabies. Isolation and further observation is advisable in these cases. An occasional client is encountered who is resentful on being advised that rabies is suspected. Cases will be met also where the animal "recovers" from what appeared to be a case of typical clinical rabies. A hasty diagnosis of rabies may be embarrassing if later it is found that bilateral fractures of the lower jaw, or a bone lodged in the mouth, caused the drooping lower jaw. It is difficult to satisfy a skeptical client under such circumstances.

In a strictly hospital practice like ours, probably it is seldom known in advance what to expect in the next patient. In the clinic the patients are presented in rotation, according to their arrival in the waiting room where the name of the owner, his address, together with the breed, name, age and sex of the animal is entered on a card. This card is presented with the animal by the owner when it is his or her turn to see the veterinarian in attendance in the clinic. On this card the veterinarian enters the diagnosis, operative or other treatment, charges, and so forth; thus at once making it a permanent record of the case.

Anything from an ordinary avulsion of a toe nail to a prospective cesarean delivery,

or a case of eclampsia, may be the next case. There are the ordinary run of cases, and while you are perhaps in the midst of treating a case of ear canker in an unruly Chow, an emergency case is rushed in out of turn for immediate attention. In order to handle these cases, do justice to the animal, and satisfy the owner, it is necessary to arrive at a diagnosis in as short a time as is possible. Every case presented for treatment is entitled to an examination. Fortunately the symptoms are so obvious and characteristic in the majority of emergency cases that but little time need be expended in further examination. A routine general examination of such cases, however, often reveals unexpected abnormalities that may be overlooked otherwise. On observing the animal as it is being led or carried in, its general appearance will usually indicate how to proceed with questioning and examination to gain the information desired. Assuming a case of apparent convulsions is being rushed in, the animal is wrapped in a blanket, leaving only the head and face visible. The owner is overly excited, but positive that a neighbor has poisoned his pet. You are expected to act on the instant to bring it back to normal. The convulsions may be due to one of several causes and it is often difficult to tell at a glance, and questioning an excited and hysterical owner does not help. Upon uncovering the animal, it is observed that it is a female and the mammary glands appear functional. You naturally will ask, "How long has she been this way? Is she nursing puppies, and how old are the puppies?" The owner will recall that as a matter of fact the dog has been rather restless and nervous for several days. There is no reason for mistaking eclampsia for strychnine poisoning, yet this can happen. Immediate and specific treatment is highly responsive in either condition, providing a correct diagnosis has been made. The convulsions may be due to food poisoning, distemper, heat, undue excitement, and so forth, where an entirely different line of treatment will be in order, and the owner may be given a more convincing prognosis if it is possible to impress upon him that a correct diagnosis of the condition has been made.

We never can predict what the next case will be.

Temperature

Although a temperature reading in cases of convulsions is not always reliable in differentiating possible causes, it is good practice to use the thermometer in every routine examination. With a few exceptions—such as over-exertion, excitement, heat prostration, and so forth—a rise of temperature indicates infection somewhere. I have often heard an owner remark, "Why, he didn't even take his temperature." Therefore, even if it means nothing more than impressing the owner that a careful examination is being made, the temperature reading should be included in all examinations. It is quite common to have a pup presented with a request for a "worming out treatment." "No, he hasn't been sick, just sliding around on the floor, is a little restless, and so forth—just symptoms of worms." In these instances we naturally do not antagonize a client. The animal is examined. The thermometer is inserted for a temperature reading as well as being used for obtaining a fecal smear. This is examined, and more often than not the pup has worms. It is quite common to find in addition to the ordinary round worm egg, hookworms and whipworms. A positive finding is convincing, and treatment is given. But the thermometer may show an abnormal temperature. On advising the owner that something more serious than worms is wrong, he will recall that for the past few days the pup has been less active, has missed a meal or two and has vomited a few times.

Obtaining the history of a case gives time to prepare a plan for handling the animal.

The owner merely requested a dose of worm medicine; the fecal smear confirmed his diagnosis. The proper dose is given. If nothing is said about the possibility of a case of distemper in the incubative stage and secondary symptoms are noted by the owner a week later, he will recall having seen a dog in the entry of the waiting room with distemper symptoms. It will be difficult to convince him that his pup had been exposed elsewhere.

All animals presented for surgical treatment should be examined very carefully before admittance—particularly for symptoms of distemper, demodex and sarcoptic mange, and ringworm in the dog; ear mites and ringworm in the cat, should not be overlooked. Any suspicious lesion should be noted, a scraping taken and identified by microscopical examination. An occasional case may slip by where fleas and lice are overlooked and if discovered a month later by the owner, he will feel certain that the animal was exposed at the hospital.

Visible Mucous Membranes

An important aid in interpreting temperature readings is found in noting the color of the visible mucous membranes. By this means it is possible also to distinguish or differentiate between local and general congestions. Any bilateral discharge from the eyelids should be looked on with suspicion of generalized infection. In a unilateral discharge, look for local irritation, foreign body, and so forth. The color denotes the quantity and quality of the circulating blood. Noting a pale anemic color will suggest the possibility of hookworm infestation, whipworm, lice, and so forth. A suddenly appearing paleness suggests shock from an unseen injury, internal injuries, internal hemorrhage, perforation of the bowel from foreign bodies, and so forth. A congested muddy color suggests intestinal toxemia. Yellow discoloration may be overlooked if the animal is examined by artificial light.

While noting the color of the gums and cheeeks, it is well to take the time to make a careful inspection of the mouth. Some of the common abnormalities often seen are: tartar, persistent decidious teeth, decayed teeth, stomatitis, gingivitis, warts, ranula, new growths, foreign bodies, pyorrhea; and quite frequently, as a sequel to distemper, there will be found an infection similar to trench mouth which has been identified as diffuse spirochetal gingivitis.

Occasionally some rather puzzling condition may be caused by abnormal tonsils. A four-year-old Boston terrier was presented for treatment for a chronic gastritis. The animal was a sad looking specimen and his general appearance indicated euthanasia as the most logical treatment. The owner had been shopping around, trying first one and then another veterinarian, and in addition had used home remedies. The condition had been under treatment for eight months. Questioning brought out the information that although the animal had retained a good appetite throughout, it could not retain fluids, and solids like meat would be taken ravishly, only to be vomited within a few minutes. The ejected meal would be swallowed several times before part of it was eventually retained. There was a bronchial cough, a moderate fever, the membranes were anemic, the animal was listless. It had had several convulsions in the past week, and there was evidence of extreme dehydration. On examination of the mouth a very fetid odor was detected; there was an ulceration of the gums, a brownish accumulation on the teeth, tartar on the teeth and several ulcerated teeth. On inspection of the throat, it was interesting to note that the tonsils were extremely abnormal in size and appeared spongy and necrotic. The owner at

this point interrupted to remind us that she wanted treatment for the dog's stomach and not its mouth, as that was being taken care of by a mouth wash. The case, however, was left in our hands and radical treatment was resorted to.

A pre-operative injection of 10 per cent dextrose in normal saline was given. This was repeated the following day when the teeth were cleaned, removed, gums treated, and tonsils removed by cauterization (radio cautery). On recovery from the nembutal anesthesia the following morning the dog drank four ounces of milk, retained it, and never missed a meal of either liquids or solids for the following two weeks while in the hospital. A complete recovery resulted. There was no treatment prescribed other than a mixture of haliver oil with viosterol and a meat and milk diet. With meat there was included one-fourth portion of fresh liver. This case is cited because of its unusual recovery, and because some one person, or persons, slipped up on not making a more careful examination.

Palpation

Many abnormalities may not be detected or properly defined by visual inspection alone, such as superficial swellings due to sprains and bruises, superficial and deep abscesses, glandular enlargements, foreign bodies in the mouth and throat, obstructions in the intestinal tract due to fecal matter; also enlargements of the liver, spleen, abnormal position of the kidneys, abnormalities of the urinary bladder and of the prostate glands. These and pregnancy and the various abnormalities of the uterus may be quite accurately identified in most instances by careful palpation.

Every case exhibiting symptoms of gastro-intestinal disorder should include in its examination, *"a very careful palpation of the abdomen."* Obstructions in the gastro-intestinal tract, due to fecal impaction, foreign bodies, invagination, and so forth, respond to proper treatment with a quite favorable prognosis if detected early. On the other hand, a delay of 24 hours or less for a correct diagnosis may change an ordinary case of "intestinal colic" into another mortality —regardless of the surgical skill or other special treatment employed.

Many cases are presented with the information that the dog swallowed a chop bone, rubber ball, rubber bone, a stone, and what not. An allowance of a liberal amount of raw or cooked hamburger, followed within fifteen minutes with a dose of apomorphine, will in many instances verify the correctness of the information. In a negative result, and where palpation is also negative and the owner is still positive of his observation in having seen the dog actually swallow the object, do not hesitate to suggest an x-ray examination.

In the nervous and frightened animal, the vicious, the obese, and in all cases where there is a tenseness or a resistance of the abdominal muscles, palpation may be facilitated by the use of morphine or nembutal to effect relaxation.

Exploratory laparotomies, if carefully planned and executed, are in many cases justified, especially if an x-ray examination is not available.

Through the practice of palpation, the sense of touch can be cultivated to an extent where in many cases the x-ray may be dispensed with except to verify your own findings or to convince an owner.

Auscultation and the Sense of Smell

The sense of hearing, with or without the aid of instruments, and the sense of smell are important aids in detecting many abnormal changes, the practice of auscultation for abnormal heart, lung and intestinal sounds, change in voice sounds characteristic in various conditions (hysteria, rabies, gastro-enterities in cats) is not to be dispensed with in routine examinations. Certain characteristic odors in skin diseases, fecal discharges, mouth odors and so forth are often diagnostic.

The Injured Animal

To most owners of a pet any injury, however trivial it may prove to be, is an emergency and immediate attention is imperative. Indifference or an apparent lack of concern on our part in these cases is likely to create an unfavorable impression. It should be our practice to respond with prompt attention.

The injury may be anything from a minor local bruise or sprain to that of a crushing of vital organs. It may be merely a shock from fright. In practically all cases there may be evidence of fright, and from slight or moderate shock to extreme shock and insensibility.

Since most injuries are a result of external violence such as being run over by an auto, bite wounds from fights, falling from a second story, etc., the first part of the examination should be to determine the presence or absence of serious complications in the animal suffering from shock. A bruise on the head may cause concussion of the brain, causing a temporary shock and presenting approximately the same symptoms seen in a case with serious internal hemorrhage.

The signs of shock as we see them in our patients are (1) pale mucous membranes, slightly cyanotic, (2) cold extremities and skin surfaces, (3) a rapid thready pulse, (4) rapid shallow respirations, (5) restlessness, (6) normal or subnormal temperature, (7) coma.

Since many of these cases of severe shock are victims of serious internal injury, accompanied by hemorrhage, prognosis should be withheld or guarded and treatment should be instituted immediately.

Fractures and Dislocations

Approximately 5 per cent of hospital cases in our experience result from injuries, and practically 80 per cent of these cases are represented by the various fractures and dislocations.

Diagnosis.—As already stated, proper treatment depends on a correct diagnosis, and the most important step to take before attempting treatment of any fracure or dislocation is a careful examination of the animal in order to eliminate, or include, probable complicating injuries. Many cases are encountered where a fracture or dislocation is the minor injury.

The common objective signs of fracture are:

1. Deformity of the part. A deviation from the normal such as shortening, angulation, rotation, abduction or adduction, swelling, etc.

2. Abnormal mobility between the broken ends. These two signs are considered positive evidence of fracture. When these symptoms are noted, we usually find a loose fracture and displacement of fragments.

3. Crepitus. This is the grating sensation transmitted through the touch when the limb is examined. This may be demonstrated by carefully rotating the lower against the upper fragment of the suspected bone. In gross lateral displacements, and so forth, crepitation is difficult to demonstrate as contact of fragments may be difficult to obtain. In these cases the fracture is so obvious that it is not necessary for evidence anyway.

4. X-Ray. This is, of course, our most valuable diagnostic instrument in fracture treatment, not only as an aid in diagnosis but in reduction also; and later to check the progress in healing. We always attempt to make a diagnosis by careful examination and then, if it is deemed necessary, check our findings with a radiograph. The x-ray equipment is almost indispensable in good fracture treatment; but on the other hand, too much dependence on radiographs is expensive and one is apt to lose the good habit of cultivating the practice of observation and palpation.

A radiograph is often necessary in order to convince a skeptical client that a fracture or dislocation exists. It is important in cases where it is not only necessary to ascertain if fracture exists, but to determine the level, type and displacement of the fragments as an aid in planning proper reduction and fixation; also in those cases of obese animals where palpation and other procedures in examination are indefinite—as in fracture of the femoral neck and dislocation of the hip. Often an obvious fracture of a leg bone is treated and in a few days there are suggestions of probable spinal injury where a lateral exposure of the vertebrae will disclose a luxation or fracture. Again, an obvious fracture—as in the femoral shaft—is occasionally complicated by a dislocation of the hip in the same leg. A

dislocation of the opposite hip also may be overlooked.

For exposure in the leg fractures it is usually best to take two views, i. e., a lateral and an anterior-posterior. This is particularly necessary in the elbow region in fractures of the condyles of the humerus, and so forth. It is also important in injuries at the stifle and hip to obtain views at different angles in order to interpret the actual displacements. Lateral views often show overlapping shadows of the fragments in perfect alignment where an A. P. view will show gross separation. Thus an apparent perfect reduction may end in a disappointment.

Pelvic exposures are best taken in a perfect dorso-ventral position. To exclude motion the animal should be given a sedative or, if possible, it should be anesthetized. To demonstrate true displacements at the hip in femoral neck fractures, and to check the accuracy in reduction, three views are indicated: namely, the thigh flexed and adducted, the thigh abducted with the limb in the neutral position, and the thigh in extension. This can be done on one film by shading the cassette with a lead apron or lead sheeting.

The subjective signs of a fracture are:

1. Loss of function of the limb. This may be partial or complete. (Loss of function is also observed in sprains, etc.).

2. Pain. Where pain and loss of function are the only signs noted, fracture should be suspected—at least until a thorough examination proves negative.

In many incomplete fractures where there is no displacement or angulation (and if examined soon after an injury there may be no visible swelling nor other evidence at the fracture site) the limb should be examined carefully by a process of elimination. Begin by first gaining the animal's confidence. This may be accomplished by stroking and handling the sound limb in various ways, as flexing and extending the joints, palpating the parts by beginning at the toes, examining each joint carefully until the animal is accustomed to handling before attempting to examine the injured limb. In most small animals it will be difficult to locate the definite site of the fracture if the animal is approached too abruptly, especially so if the injured limb is handled carelessly or roughly. It may happen that an incomplete fracture is completed in the handling. If a definite bone is suspected, as for instance, the radius, proceed carefully. Let it alone for the time being, but palpate the shoulder, spring the condyles of the humerus at the elbow, test the olecranon, then perhaps test the digits, and finally on approaching the fracture site there will be a definite reflex and the animal will show evidence of pain over the fracture area. If this sensitive area is in close proximity to the wrist joint, it may be an incompleted colles fracture, *or it may be a sprain at the wrist.* It is often difficult, and probably impossible, to differentiate wrist sprain from wrist fracture. In a young animal it may be an epiphyseal sprain (or a separation without displacement).

The reflex of pain in a part, elicited by palpation or springing, is spoken of as "point tenderness." In a differential diagnosis this is of diagnostic value in that there is a more diffuse area of sensitivity in a sprain, in contrast to a limited area in a fracture.

In all these possible conditions, unless an x-ray is available for a positive diagnosis, a tentative diagnosis of fracture should be made and the part so treated. These borderline cases are the ones where mistakes may be made. If overlooked, green-stick fractures of the radius and ulna and tibia will result in unsightly bowing, especially in the low fractures. A careful examination of the skin, especially in cats, will often eliminate the diagnosis of fracture by revealing small puncture wounds caused by biting or clawing.

Fractures in the limbs below the stifle and elbow usually are detected quite readily. Here the bones are superficial and are for the most part palpable. Comparisons with the normal limb are easily made and even slight deformities may be recognized.

The diagnosis of fracture in the humerus and femur is more difficult (excepting loose fractures). These bones are deeply situated and palpation is less definite because of the heavy muscles enveloping them, and be-

cause of swelling from considerable extravasation of blood from the torn vessels as a result of the injury. For accuracy in reduction and fixation, one should be able to visualize the displaced position of the fragments in the various levels in order to make the necessary replacement by traction and manipulation and to plan proper fixation to hold a reduction after it is made.

The Laboratory Dog

No paean is sung, no monument unveiled to those thousands of forgotten canine heroes whose supreme sacrifice is recorded only to the interested few.

Men die for men and history's pages are emblazoned with their deeds, but when dogs die for dogs, or for men, in the obscure warfare against disease, cryptic records are all that remain to register their sacrifice.

Sacrifice has been the ideal of but few, in the labors that have served in the advancement of mankind. Apathetic and ignorant of the truths of the contribution of "dogs against death," are those whose clamor is raised in an attempt to nullify the achievements. They are content to live in smug comfort; unappreciative that they and their children are safe from the ravages of plague. The milestones that marked the short road to Death are gone. Yellow fever, smallpox, typhoid, diabetes, pernicious anemia, are but a few of former scourges that no longer destroy on the highway of Life.

If the laboratory dog but knew that he held within his body the precious requisite that serves his master—Man—he would gladly sacrifice himself on this ladder of science, as thousands of his kind have done, willingly, to protect their masters in everyday emergencies. Yes, and if he knew that he assisted in stamping out the grim reaper of dogdom, distemper, from the world, he would contribute in the same heroic way.

Pity the human so devoid of understanding that he cannot rise to this spirit of sacrifice which is inherent in his four-footed friend. In the quiet of a laboratory this human cowardice is overcome by the few who have the courage, the devotion and the spirit of sacrifice to carry on for mankind the task of meeting Death's new challenges.

These research workers "without money and without price" toil with man's greatest friend and unflinchingly share this spirit of sacrifice by submitting their own lives for the final test. These human heroes wearing themselves away in defense of their fellows, making life more safe for all, face anathema as human monsters. They are pictured as blood loving ogres by an unknowing press, whose public echo their charges, blindly crying to end this battle with Death . . . . while Death chuckles in delight at the support he receives from poor mortals who attempt to make his way easier.

The tumult falls on deaf ears while these workers go on with their task, inspired and encouraged by the spirits of their predecessors, and the laboratory dog stands by, awaiting his call to serve.

H. J. Mostyn.

New York.

Illness a "Big Business"

Community responsibility for the care of the sick is an essential part of the development of civilization, for the discharge of which a huge structure has developed, ranking in importance, not only because of its essential necessity but also because of its economic magnitude and ramifications, with any of all those of which modern civilization can boast.

Hospitals are an integral part of this structure and, although not commonly regarded as "Big Business," properly belong in this category; for the seven thousand hospitals in the United States in round figures represent a capital investment of more than three billions of dollars, a capital sum exceeded by but few of the great industries.—*Jnl. Lab. and Clin. Med.*